L.W.P.
Flora W. Patterson

BULLETIN No. 170. DECEMBER, 1899.

# New York Agricultural Experiment Station.

GENEVA, N. Y.

IMPERIAL BUREAU OF MYCOLOGY
13 JUL 1921

## COMMON DISEASES AND INSECTS INJURIOUS TO FRUITS.

S. A. BEACH, V. H. LOWE AND F. C. STEWART.

PUBLISHED BY THE STATION.

## BOARD OF CONTROL.

GOVERNOR ROOSEVELT, Albany.
WILLIAM C. BARRY, Rochester, Monroe Co.
S. H. HAMMOND, Geneva, Ontario Co.
MARTIN V. B. IVES, Potsdam, St. Lawrence Co.
A. C. CHASE, Syracuse, Onondaga Co.
F. O. CHAMBERLAIN, Canandaigua, Ontario Co.
F. C. SCHRAUB, Lowville, Lewis Co.
NICHOLAS HALLOCK, Queens, Queens Co.
LYMAN P. HAVILAND, Camden, Oneida Co.
G. HOWARD DAVISON, Millbrook, Dutchess Co.

## OFFICERS OF THE BOARD.

MARTIN V. B. IVES, *President.*
W. O'HANLON, *Secretary and Treasurer.*

EXECUTIVE COMMITTEE.

S. H. HAMMOND, W. C. BARRY, F. O. CHAMBERLAIN, F. C. SCHRAUB, LYMAN P. HAVILAND, G. HOWARD DAVISON.

## STATION STAFF.

W. H. JORDAN, Sc. D., *Director.*

GEO. W. CHURCHILL, *Agriculturist and Superintendent of Labor.*
WM. P. WHEELER, *First Assistant (Animal Industry).*
F. C. STEWART, M.S., *Botanist.*
F. H. BLODGETT, M.S., *Assistant Botanist and Entomologist.*
F. M. ROLFS, B.S., *Student Assistant in Botany.*
L. L. VAN SLYKE, PH.D., *Chemist.*
C. G. JENTER, PH.C.,
*W. H. ANDREWS, B.S.,
J. A. LECLERC, B.S.,
*A. D. COOK, PH.C.,
FRED D. FULLER, B.S.,
E. B. HART, B.S.,
*CHAS. W. MUDGE, B.S., *Assistant Chemists.*

H. A. HARDING, M.S., *Dairy Bacteriologist.*
L. A. ROGERS, B.S., *Student Assistant in Bacteriology.*
GEO. A. SMITH, *Dairy Expert.*
FRANK H. HALL, B.S., *Editor and Librarian.*
VICTOR H. LOWE, M.S.,
†F. A. SIRRINE, M.S., *Entomologists.*
S. A. BEACH, M.S., *Horticulturist.*
WENDELL PADDOCK, B.S., *Assistant Horticulturist.*
FRANK E. NEWTON,
JENNIE TERWILLIGER, *Clerks and Stenographers.*
A. H. HORTON, *Computer.*

Address all correspondence, not to individual members of the staff, but to the NEW YORK AGRICULTURAL EXPERIMENT STATION, GENEVA, N. Y.

The Bulletins published by the Station will be sent free to any farmer applying for them.

---

*Connected with Fertilizer Control.
†Connected with Second Judicial Department Branch Station.

BULLETIN No. 170.

# COMMON DISEASES AND INSECTS INJURIOUS TO FRUITS.

S. A. BEACH, V. H. LOWE AND F. C. STEWART.

## INTRODUCTION.

The purpose of this bulletin is to furnish the fruit-grower with a concise account of the common diseases and insects most injurious to cultivated fruits in New York State and to present up-to-date directions for fighting them most efficiently and economically. The accompanying index makes it easy to find any subject treated in the bulletin.

The preparation of spray mixtures and the apparatus for applying them are not treated here because they are discussed at length in Bulletin 121 and its appendix. Both Bulletin 121 and this bulletin should be preserved for reference.

The various fruits are taken up in alphabetical order and under each one the diseases are first considered, then the insects. In the consideration of each particular disease or insect, it is the general plan of the bulletin to give first, one or more descriptive paragraphs setting forth its general appearance, the chief features of its life-history and its economic importance. Then follows a statement of the remedial or preventive treatment which is recommended or suggested by the authors. Where nothing can be positively recommended, suggestions are made, pointing out what appears to be the most promising line of treatment. Recommendations quoted from other authors are given on their authority.

In some instances it is possible to combat various diseases and insects with one general line of treatment. In such cases the general treatment which is advocated is stated after the several diseases and insects have received individual consideration.

## APPLE DISEASES.

### APPLE TREE CANKER.

(*Sphæropsis malorum* Pk.)

The term canker, as applied to diseases of trees, is used to designate an injury that destroys the bark and lays bare portions of wood. It has been discovered that a canker which is doing serious damage to apple orchards of this State, is caused by the fungus, *Sphæropsis malorum* Pk. This is the same fungus that causes the black rot of apple, pear and quince fruit. The disease usually attacks the larger limbs where it may be detected by the swollen appearance of the limbs, the rough, black bark, and in many instances bare wood, black and decaying. The area of bare wood is, in many instances, not large, but the extent of rough, swollen bark may be several feet. The wounds and unhealthy bark interfere with the circulation of the sap and where a majority of the limbs are attacked the tree is greatly enfeebled and may die from the effects.

Some varieties, as the Esopus Spitzenburg and Twenty Ounce, are very susceptible to the attacks of this fungus, and many other common sorts are by no means exempt.

*Treatment.*—No experiments in treating this disease have, as yet, been completed; therefore, no definite line of treatment can be given. The following suggestions are based on observations and studies of the disease as it occurs in a large number of orchards: (1) Remove all diseased limbs wherever practicable. (2) When spraying with Bordeaux mixture for apple scab pay special attention to coating the limbs with the mixture as well as the leaves and fruit. An earlier treatment given when the leaf-buds are beginning to open may also be advisable. (3) In some instances it will probably pay to scrape or cut the diseased bark from the canker spots and scrape the rough bark from other portions of the tree. The trunk and larger limbs may then be washed with thick Bordeaux mixture or with one of the washes that are recom-

mended for this purpose. The following formula is given as a type of these washes, as it contains the important ingredients :

WASH FOR TREE TRUNKS.

| | |
|---|---|
| Whale oil soap | 1 pint. |
| Slaked lime | 3 pints. |
| Water | 4 gallons. |
| Wood ashes | to thicken as desired. |

Dissolve the soap in hot water, then stir in the lime. When the ingredients have been reduced to a smooth state by stirring, dilute with water to four gallons, then stir in wood ashes till the wash is of the desired consistency.

FIRE BLIGHT.

The same as the "Fire Blight of the Pear" discussed on page 422.

FLY SPECK.

(*Leptothyrium pomi* (Mont. & Fr.) Sacc.)

This disease, although commonly associated with sooty blotch, on both apples and pears, is probably distinct from it. It appears as groups of black dots resembling large fly specks. The specks are not caused by any insect but by a fungus which, like the sooty blotch fungus, is confined exclusively to the surface of the fruit.

The treatment for fly speck is the same as for sooty blotch. See page 388.

LEAF SPOT.

(*Phyllosticta* spp.)

*Description.*—This disease is caused by two very closely related species of fungi. It attacks only the foliage. Very soon after the buds break, the young leaves show small, reddish-brown spots. As the leaves grow, the spots enlarge. When the leaves are full grown the spots are brown, brittle, circular, with sharply defined outline, and vary in diameter from one-twelfth to one-fourth of an inch. In July, several black specks of the size of a small pin head appear at the center of some of the spots, on the upper side of the leaf. Many spots, however, never show the black specks.

Affected leaves fall prematurely. In severe attacks the trees may be almost completely defoliated by July 1. The disease is most troublesome in wet seasons. It is more prevalent on Long Island and in the Hudson Valley than in other parts of the State.

*Treatment.*—Leaf-spot is only partially prevented by the treatment recommended for scab. See page 386. Where the disease is troublesome we suggest that this treatment be preceded by a spraying with Bordeaux mixture (1–to–11) formula) just as the buds show green at the tips.

### RUST.

(*Gymnosporangium* spp. Syn. *Rœstelia* spp.)

*Description, etc.*—Rust is a disease in which circular, orange-colored spots about one-fourth of an inch in diameter appear on the leaves in June. It also produces yellow spots on the fruit at about the same time.

It may be caused by several species of fungi belonging to the genus *Gymnosporangium.* The species of this genus are peculiar in that in one stage of their life cycle they live upon the apple and some other closely related plants, while in another stage they inhabit the red cedar and its relatives. *Gymnosporangium macropus* is the most common cause of apple rust. Its other stage occurs on the red cedar where it produces the so-called cedar apples.

In New England and some parts of the South apple rust is a destructive disease, but in New York it is of rare occurrence except on Long Island. Some varieties are attacked much more severely than others. Rust should not be confused with russeting.

*Treatment.*—Rust is difficult to combat. Spraying seems to check it but little. Since the red cedar harbors one stage of the fungus which is the chief cause of rust, it is good policy to destroy, so far as practicable, all red cedars in the vicinity of the orchard.

### RUSSETING AND BELTING OF THE FRUIT.

*Description.*—Both apples and pears are subject to a trouble known as russetting or belting. It is sometimes also called rust, but this name is objectionable because it leads to confusion with

the true apple rust discussed above which is a very different thing.

Fruits entirely sound and perfect in form may show areas on which the skin is rough, brown and corky. These areas may be irregular in outline, in which case the fruit is said to be russeted, or they may form a definite zone around the fruit producing the condition known as belting.

*Cause.*—This trouble is not caused by any insect or fungus. It is due to some irritation of the skin of the fruit, and may be brought about in three principal ways:

(1) By the occurrence of long continued cloudy, wet weather immediately after the setting of the fruit;

(2) By spraying with Bordeaux mixture during cloudy, wet weather;

(3) By the freezing of dew on the fruit while it is young and tender. In this case the injured area usually takes the form of a zone or belt.

No remedy is known.

### SCAB.

(*Venturia inquæalis* (Cke.) Aderh.[1])

*Description.*—The worst disease with which the apple growers of this State have to contend is one commonly known as "apple scab" or "cracking of the apple." It is caused by a fungus which attacks the skin of both foliage and fruit.

On the fruit the spots are at first usually circular in outline and have a very dark velvety-green surface, but afterwards they become nearly or quite black. In some cases the diseased tissue finally scales off leaving a scar with a corky, russet surface. The spots vary in size from small dots to the large irregular patches which are formed when two or more smaller spots coalesce. Where the spots are large the fruit may become one sided or otherwise distorted, and often it cracks open. For this reason the disease is sometimes called "the cracking of the apple."

On the leaves the fungus has the appearance of a dark mold. It is found in spots on both the upper and under surfaces. The

[1] This is the name given to the ascosporic stage of *Fusicladium dendriticum* (Wallr.) Fckl.

disease may cause the leaves to be much crumpled and finally show brown, dead tissue which breaks away leaving the foliage torn and ragged, or the entire leaf may drop off.

Some varieties are especially susceptible to its attacks, and it is not unusual to see a very large proportion of their fruit badly cracked by it. On the other hand, there are varieties which are generally quite resistant, on which the scab spots increase comparatively slowly, and the cracking of the fruit is seldom or never seen.

On the fallen leaves of the previous season, there develop, in the spring, perithecia within which are perfected spores for the propagation of the fungus.[2] The fungus is known to begin its attacks very early in the season, for occasionally it may develop sufficiently to be discovered by the naked eye on unopened blossom buds. In seasons especially favorable to its early development it has been observed to cause great injury early in the season, destroying the blossoms and the young fruit. In order to control the disease, therefore, it is important to begin treatment early. It must be borne in mind that the treatment is effective by preventing the germination of the spores rather than by killing the fungus after it has become established either on the foliage or on the fruit.

*Treatment*—The scab may be controlled by proper spraying with Bordeaux mixture. Fortunately these treatments may be combined with others which are advocated by the Entomologist against the case-bearers, bud moth, canker worm, codling moth and other injurious insects. The combined treatment advocated for scab, leaf-spot, canker disease, codling moth, canker worms, and various other insects is given on page 399. As there stated, the scab may generally be controlled by three applications of the Bordeaux mixture if made at the proper time, and very thoroughly. Where but three treatments are given, the first spraying should be made after the buds break but before the blossoms open; the second, just after the blossoms fall; and the third, from ten to fourteen days after the second.

*Winter treatment for apple scab.*—Spraying for apple scab while

[2] Aderhold, Dr. Rud. Die Fusicladien unserer Obstbäume, I Theil Landw Jahrbücher, **25**: 880–914. 1896.

the buds are dormant has not been found profitable. The later treatments advocated above *must* be made in order to control the disease. When these are made the winter treatment does not bring sufficient additional benefit to justify the expense of making it against the scab alone, but it may pay when directed also against the canker disease and combined with some application which must be made against insects such as case-bearers or bud moth.

It is known that the scab fungus lives during winter on the fallen leaves and in the spring produces spores by means of which it spreads to the new foliage. Probably it may exist during winter to some extent on the bark of young twigs, also. Granting that this is the case and that a large part of the fungus on the tree is killed by winter treatment, which is improbable, it is evident that when the new foliage appears it must be covered with some fungicide to protect it from the spores produced on the fallen leaves. The fruit grower should direct his efforts toward preventing the germination of the fungus spores on the foliage, rather than attempt to kill the fungus in winter quarters. The Bordeaux mixture treatment is a preventive rather than a cure.

### SCALD.

Stored fruit of some varieties of apples, notably Rhode Island Greening, sometimes becomes discolored and presents an appearance which is commonly called "scald." It is not caused by any fungus. Jones[3] has made some investigations concerning the cause of scald. The following account is based on his reports.

*Description.*—The scald first appears as a light brownish tinge of the skin either in fairly well defined spots or more or less diffused. The discolored areas enlarge with more or less rapidity coalescing until the entire surface of the apple may be involved. At the same time the color changes from a lighter to a darker brown shade and usually terminates in a black rot. At the beginning of the trouble the flesh appears sound, the discoloration involving only the outer cells of the fruit. Afterwards, the

[3] Jones, L. R. Vt. Agr. Exp. Sta. Ann. Rept. 1896–97: 55–59 and 1897–98: 198.

flesh also becomes discolored and is finally invaded, in most cases, by some fungus, but the primary cause of the scald cannot be attributed to any fungus or other parasite.

It appears certain that the primary cause of the scald is to be found in climatic and orchard conditions, the conditions of the storehouse being secondary. The fruit which is grown and matured under favorable conditions can be carried through the normal season of keeping for fruit of that variety without the appearance of the scald. If grown under unfavorable conditions the fruit requires very careful attention to the temperature and perhaps other store-room conditions if it is kept for any length of time without scalding.

### SOOTY BLOTCH.

(*Phyllachora pomigena* (Schw.) Sacc.)

*Description, etc.*—In wet seasons and especially in damp, shady situations, apples are subject to the attacks of a fungus which causes sooty blotches on the fruit. These blotches are sooty-black, circular, and measure from one-fourth to one-half an inch in diameter. Frequently the blotches coalesce, giving the fruit a sooty, dirty appearance.

Sooty blotch is sometimes mistaken for scab. A striking point of difference between the two diseases is the manner in which they attack the fruit. Sooty blotch is confined to the surface of the fruit and may be readily removed by rubbing, while the scab destroys the cuticle (outer layer of the skin) thus making a spot which cannot be removed by rubbing.

Being superficial in its growth, the fungus does the fruit no harm except to make it unsightly and, consequently, less salable.

Under favorable conditions sooty blotch may appear upon almost any variety, but it seems to have a preference for some of the fair skinned varieties such as Bellflower, Fall Pippin and Rhode Island Greening. Pears, also, are subject to it.

*Treatment.*—In orchards sprayed for apple scab the fruit will not, ordinarily, suffer much either from sooty blotch or the fly speck disease. However, for the best results with both of these diseases it seems necessary to make one or two sprayings in July in addition to those made in treating apple scab.

## APPLE INSECTS.

### BORERS.

Several species of borers attack the apple tree. As a rule they will be found in the trunk, but occasionally in the larger limbs. A small species sometimes infests the twigs. The presence of the grubs is usually indicated by the discolored bark and by their castings. The following species are most commonly met with in this State:

#### THE FLAT-HEADED APPLE-TREE BORER.

(*Chrysobothris femorata* Fab.)

*Description.*—The female beetle lays its eggs in the bark late in June or in July. These hatch in a few days and the grubs at once gnaw their way into the sap-wood where they live and feed from one to three years before reaching full size. A short time before pupation they go deeper into the solid wood. The adults are steel-colored beetles, flattened above and with irregular depressions on the wing covers.

*Treatment.*—The trees should be examined at least once a year and the borers dug out with a knife or killed by inserting a flexible wire into the burrows.

#### THE ROUND-HEADED APPLE-TREE BORER.

(*Saperda candida* Fab.)

*Description.*—The life-history of this species is similar to that of the preceding except that the grub requires but about a year to reach full growth. In both the grub and adult stages the body is more nearly cylindrical in outline. The adult is prominently marked by two broad, nearly parallel, white lines extending the full length of the body.

*Treatment.*—The same as for the preceding species.

### LEAF-EATING INSECTS.

#### THE APPLE-TREE TENT CATERPILLAR.

(*Clisiocampa americana* Harr.)

*Description.*—This tent caterpillar feeds upon a variety of fruit and other trees and is especially injurious to the apple. The eggs

are laid in July in conspicuous brown rings or masses about the smaller twigs. The caterpillar is developed in the egg in the fall but does not emerge from the egg shell till early in the following spring. The caterpillars from each egg mass form a colony and spin a tent in which they stay when they are not feeding on the leaves of the tree.

After they are full grown, that is about five or six weeks after hatching, they spin their cocoons. The adults, which are brown moths with two oblique, parallel, white lines on the fore wings, emerge in the latter part of June or early in July.

*Treatment.*—The egg masses may easily be gathered in winter and burned. The caterpillars may be destroyed while in their nests or by applying a poisonous spray to the foliage. It is easier to kill the caterpillars by spraying when they are very small than it is after they have become large. It is important, therefore, to make the first spraying just before the blossoms open because that is about the time the caterpillars emerge from the egg. The cocoons are quite conspicuous and their destruction will aid materially in lessening the numbers of females to lay eggs.

For further information relative to these insects and their near relatives, the forest-tent caterpillars, which are sometimes injurious in orchards, consult Bulletins 152 and 159 of this Station.

### BUD MOTH.

(*Tmetocera ocellana* Schif.)

*Description and life-history.*—The young of the bud moth are small brown caterpillars about half an inch in length. During the winter they live in small, oval, silken cases, attached firmly to the bark of the twig. As the caterpillars are very small when winter sets in, about one eighth of an inch in length, their silken cases are also small and hence easily overlooked. During this period of their lives the caterpillars are green in color.

About the time that the buds begin to swell in the spring, the caterpillars come forth and bore into them, thus early protecting themselves against insecticides. As the young leaves and flowers unfold the caterpillars form nests for themselves by tying the leaves together, making their presence quite conspicuous. They do not leave these nests in feeding. During June they

reach full growth and change to the chrysalis stage in the nest. In about ten days a small brown moth escapes. This is the adult: The eggs are laid on the under side of the leaves. These soon hatch and the young caterpillars feed on the under sides of the leaves, protecting themselves by a thin, silken web. Before winter approaches they migrate to the twigs and form the silken cases in which, as above stated, they live over winter.

*Treatment.*—The only available time for effective treatment is just before the buds begin to swell, the object being to cover the buds with poison so that the young caterpillars will be poisoned as they gnaw into the bud. To make the work thorough, two applications will usually be required. Paris green or some other good arsenical should be used. If it is desired to treat the trees for apple scab, Bordeaux mixture may be combined with the Paris green for either of the above treatments. See page 399.

## CASE BEARERS.

PISTOL-CASE-BEARER.[4] (*Coleophora malivorella* Riley.)

CIGAR-CASE-BEARER. (*Coleophora fletcherella* Fern.)

During the past three or four years these two insects have become very troublesome in this State. Their principal food plant is the apple but they also feed upon the pear and quince and probably other fruit trees. The life histories of the two species are very similar. That of the pistol-case-bearer is as follows :

*Descriptions and life history.*—The young caterpillars live over winter in little pistol-shaped cases of silk which are attached on end to the twigs usually near and sometimes upon the buds. These cases measure about one-eighth of an inch in length and resemble the bark in color. The winter cases of the cigar-case-bearer are more flattened laterally and are somewhat crescent shaped. They are also lighter in color and are more frequently found in sheltered places in the angles of the twigs.

Early in the spring, a short time before the leaf buds burst, the hibernating case-bearers become active. They attack the growing buds gnawing through the outer covering to feed on the tender tissues beneath. Later in the season they feed on the

[4] This species is discussed in detail by Lowe in Bulletin 122 of this Station.

young leaves making small round holes through the cuticle and feeding, in much the same manner as a true leaf miner, on the softer tissues beneath. In doing this the caterpillars do not usually leave their cases but reach out as far as necessary. As they become larger and stronger they devour the entire leaf with the exception of the midrib and large veins. They also attack the flower buds, flowers and fruit.

About the middle of May the case-bearers have become full grown and are ready to pupate. They have enlarged their houses as their growing bodies demanded until now the cases measure about one-fourth of an inch in length. The case-bearers migrate to the twigs and attach their homes firmly on end to the bark. Before the transformation to the pupa stage takes place the caterpillars turn around in their cases so that their heads are toward the upper or curved ends. The pupa stage lasts about two weeks.

The principal difference in appearance between these two species is apparent at this time. The case of the cigar-case-bearer is straight and closely resembles a miniature cigar; while, as previously stated, that of the pistol-case-bearer slightly resembles an old fashioned pistol.

The adults of both species are moths measuring about half an inch from tip to tip when the wings are spread. The color of the former is steel gray, the latter is marked with brown. The moths appear during the latter part of May or early in June. The eggs of both species are deposited singly on the under sides of the leaves. They hatch in about ten days or two weeks. The young caterpillars feed on the tender pulp of the leaf. During September they migrate to the smaller branches and twigs, to remain until spring. Thus there is but one annual generation.

*Treatment.*—For general treatment advocated against these insects, see page 399. The first treatment is of especial importance, the object being to have the buds coated with poison so that the first meal of the little caterpillars will be a poisoned one. A second application may be made just as the leaves unfold and a third if needed.

### CANKER WORMS.

Although there are several species of canker worms quite common to the apple orchards of the State there are but two

species that often occur in sufficient numbers to do serious injury. These are the spring canker worm (*Paleacrita vernata* Peck) and the fall canker worm (*Anisopteryx pometaria* Harr.). The former is the more common and injurious of the two. The life histories of the two species are very similar except that the eggs of the spring canker worm are laid in the spring and those of the fall canker worm in the fall. The eggs of both species hatch in the spring about the time the leaf buds are unfolding.

*Descriptions.*—The eggs of the former species are placed somewhat promiscuously in sheltered places on the twigs. They are small oval eggs and the shell has a brilliant pearly luster. The eggs of the latter species are placed on end side by side in quite regular masses. They are somewhat cylindrical but smaller at the base and flattened at each end.

When first hatched the caterpillars of both species are very small and of a light green color. They devour the leaves rapidly. When disturbed they will drop, suspending themselves by silken threads. When mature they are about an inch long and vary in color from light green to darker shades. When ready to pupate they go into the ground, where the cocoon is spun and the chrysalis formed. Most of the spring canker worms remain in the ground until the first warm days of the following spring, but those of the other species come out of the ground in the fall. The adults of both species are moths. The females are wingless and the males winged.

*Treatment.*—There are two principal methods of combating these insects. First the females may be trapped while endeavoring to ascend the trunk of the tree. Numerous traps have been tested including bands of tin, cloth, waste wool, tarred paper and certain chemical preparations. Several patent metal devices for trapping the moths have been put upon the market recently. The most important point in connection with the use of traps in general is to put them on early in the season. It is usually advisable to put the metal traps in place early in the fall to catch the moths of the fall canker worm. They will then be in place for the earliest moths of the spring species.

Second, the caterpillars may be successfully combated by spraying the trees with Paris green or some other equally effective

arsenical insecticide. See page 399. Two and occasionally three applications are usually necessary. Make the first application just as the young leaves are unfolding, and the second about a week later.

Regular annual spraying with a good arsenical compound is especially important in this case. Orchards thus treated are not as likely to become seriously infested with these and other leaf eating insects as the orchards which are sprayed irregularly or not at all.

## FRUIT INSECTS.

### CODLING MOTH.

### (*Carpocapsa pomonella* Linn.)

*Descriptions.*—This is the insect that causes "wormy" apples. The recent investigations of Washburn, Card and Slingerland have thrown new light on certain stages of its life-history. It is now known that the eggs, which are whitish, oval discs, may be laid promiscuously upon the fruit or even upon the twigs and leaves. It is probable that they are not laid until after the blossoms have fallen. The period of incubation is about a week.

According to Slingerland[5] about 75 per ct. of the caterpillars enter the fruit at the blossom end. The caterpillars of the second brood often enter on the side of the fruit. They are full grown in twenty to thirty days. When once within the fruit they usually remain until ready to pupate. The cocoons are made in any convenient, protected place, as under the loose bark of the trunk or larger branches of the tree, or in near-by rubbish. Some of the caterpillars remain in the cocoons over winter, while others soon transform to the pupa stage forming a more or less complete second brood. These are sometimes very abundant in late summer and in autumn. The adult is a small brown moth measuring about ¾ of an inch from tip to tip when the wings are spread.

Those who wish an exhaustive treatise on this insect should consult Prof. Slingerland's bulletin.[6]

*Treatment.*—A considerable percentage of the worms can be killed by spraying within the first week after the blossoms have

[5] Cornell Univ. Agr. Exp. Sta. Bul. 142 : 21.

[6] l. c.

fallen. The calyx end of the fruit must be filled with the poison before the calyx lobes close, hence much pains should be taken to make at least one thorough application before that occurs.

### GREEN FRUIT WORMS.

(*Xylina* sp.[7])

*Descriptions.*—These insects sometimes do serious injury by eating into the young apples. They also attack pears, plums, peaches and quinces. The full-grown caterpillars measure from an inch to nearly an inch and a half in length. They are green or yellowish-green in color with various irregular markings and stripes, the most prominent of the latter being a narrow, cream-colored one down the middle of the back and a wider one along each side.

The caterpillars are most abundant during May, soon after the fruit has formed. They continue feeding until about the middle of June. They feed mostly at night, resting on the under sides of the leaves during the day. When full grown they go into the ground, form a rough cocoon and pupate. The adults, which are dull-colored moths measuring about two inches from tip to tip with the wings spread, come forth in the fall and remain over winter in some sheltered place, laying their eggs in the spring.

*Treatment.*—These insects have proven difficult to control. Experiments by Lowe with Paris green, one pound to 100 gallons of water, applied to the infested trees when the caterpillars were about half grown, gave very unsatisfactory results. It is not improbable, however, that had the experiments been made earlier while the caterpillars were small the poison would have had more effect. Where practical, as in the case of small trees, the caterpillars may be jarred off in the same manner as the plum curculio.

### MAGGOT.

(*Rhagoletis pomonella* Walsh.)

*Description.*—This insect is popularly known as the "apple maggot" or "railroad worm." It is one of the most important

[7] For a more complete account of these insects see Cornell Univ. Agr. Exp. Sta. Bul. No. 123, by M. V. Slingerland.

species that attacks the fruit. Its life-history has been fully worked out by Dr. F. L. Harvey.[8] The adult insects are two-winged flies. They appear in June. The female punctures the skin of the fruit with her sharp ovipositor and lays her eggs just beneath. In a few days the eggs hatch into white maggots which make numerous irregular channels in the pulp of the apple, enlarging them as the maggots increase in size. This injury often does not show on the outside, and hence infested fruit may be harvested and unintentionally sold as good. Badly infested fruit usually falls early.

The maggots leave the fallen fruit and enter the ground to pupate, remaining until the following spring before emerging as adults.

The apple maggot appears to be spreading in this State, and as it is capable of doing great injury it should be carefully watched for and promptly checked when found.

*Treatment.*—This insect has proven a difficult one to control. As the maggots work only within the fruit, spraying the trees will have no effect. Probably the most practical remedy is the immediate destruction of the windfalls in infested orchards. This may be conveniently done by allowing hogs and sheep to run in the orchards. Fall plowing will have some effect by destroying many of the pupæ in the ground.

### PLANT LICE.[9]

Several species of plant lice attack the apple, but the most common in this State is the apple-tree aphis, *Aphis mali* Fab. This is the little, green louse that attacks the buds and leaves in the spring. It often occurs in great numbers on the under side of the leaves, sucking the sap from the tissues. This irritation causes the leaves to curl, thus affording partial protection to the insects. The winter is passed in the egg stage. Many generations and countless individuals, both winged and wingless, are produced during the summer. They secrete a clear liquid (honey dew)

[8] Maine Agr. Exp. Sta. Ann. Rept. 1889: 190.

[9] For a further discussion of plant lice see Bulletin 139 of this Station; by V. H. Lowe.

which sticks to the leaves and twigs and finally turns black, because of a black fungus which grows in it.

*Treatment.*—The trees should be carefully watched and, when the lice first appear, sprayed thoroughly with a solution of whale oil soap and water—one pound to seven gallons. The lice may appear any time after the buds burst. It is important to give the infested trees at least one or, as is often necessary, two thorough applications before the leaves have become curled. It will be very difficult to reach the lice when they are protected by the curled leaves. The spray should be directed toward the under side of the leaves.

## INSECTS ATTACKING TRUNK AND BRANCHES.

### THE WOOLLY LOUSE OF THE APPLE.

(*Schizoneura lanigera* Hausm.)

This insect is easily detected by the white wool-like substance which the lice secrete and which clings to their bodies. They attack both the roots and young branches causing gall-like swellings. They are especially injurious to young trees and sometimes do serious injury to new grafts.

*Treatment.*—When occurring upon the roots considerable relief will usually result from the application of finely ground tobacco dust about the infested roots. If the branhces also are attacked, they should be trimmed off where practicable and burned. If considered more desirable, the lice may be killed by spraying with a solution of whale oil soap, one pound to five gallons of water, or kerosene emulsion, one part to five parts of water. When but few lice occur in small colonies on the trunk or large branches they may be easily and quickly killed by applying pure kerosene oil to the infested parts.

Some Australian horticulturists hold that injury from the woolly aphis can be avoided by selecting varieties the roots of which are proof against these insects. Wickson states[10] that "the Northern Spy is on the whole the best, but it has been shown that the roots of seedlings grown from Northern Spy seed vary somewhat in degree of resistance."

[10] Univ. of Cal. Agr. Exp. Sta. Seed Bulletin 1898–9 : 7.

SCALE INSECTS.[11]

The scale insects include some of the most common and destructive insect pests of the orchard. Two species common in the apple orchards of the State are the oyster-shell bark louse, *Mytilaspis pomorum* Bouché, and the scurfy bark louse, *Chionaspis furfurus* Fitch. The San José scale, *Aspidiotus perniciosus* Comst., also attacks the apple. These insects are especially injurious to young orchard trees. The former two species pass the winter in the egg stage, the eggs having been deposited under the scales of the females. The eggs hatch in this climate in the spring, varying according to the season, from late in April or early May until June. The young lice soon settle down and insert their sharp threadlike mouth parts into the tender bark from which they suck the sap. The females form the oyster-shell-like scales, or, in the case of the other species, the thinner, more oval, whitish scales. The scales of the males of both species are more delicate, nearly white, and larger and more slender. The adult males are delicate two-winged insects.

*Treatment for oyster-shell bark-louse.*—Treatment may be made in the spring by spraying the trees as soon as the eggs hatch, either with whale oil soap, one pound to seven gallons of water, or kerosene emulsion, one part to seven parts of water. One or more applications should be made as required. For treatment of scurfy bark-louse see page 429, and for San José scale page 428.

[11] For a further discussion of these insects see Bulletin 136 of this Station.

GENERAL TREATMENT AGAINST DISEASES AND INSECTS WHICH ATTACK THE APPLE.

| When to spray. | What to use and what the treatment is for. |
|---|---|
| 1. Just before leaf buds burst. | Paris green [12] against bud moth and case-bearers. |
| 2. Just as leaf buds show green at the tips. About a week later than 1. | Bordeaux mixture [13] against scab, canker disease and leaf spot.<br>Paris green [12] against bud moth, case-bearers, canker worms, tent caterpillar and various other leaf-eating insects. |
| 3. Just before blossoms open. From seven to ten days later than 2. | Bordeaux mixture [13] against scab and leaf-spot. *The most important single application. Apply thoroughly.*<br>Paris green [12] against canker worms, tent caterpillar and various other leaf-eating insects. |
| 4. Just after blossoms fall. | Bordeaux mixture [13] against scab and leaf-spot. A very important application; make it promptly and thoroughly.<br>Paris green [12] against codling moth, canker worms, tent caterpillar and numerous other leaf-eating insects *The most important application against codling moth.* |
| 5. From ten to fourteen days after 4. | Bordeaux mixture [13] against scab and leaf-spot. If weather has been cool and wet apply with especial thoroughness.<br>Paris green [12] against codling moth. |

[12] Paris green should be used at the rate of one pound to 150 gallons of water. If used alone, about two pounds of fresh slaked lime should be added to make it adhere and to prevent injury when applied to foliage. Green arsenite of copper, arsenite of lime or other poison may be used instead of the Paris green as directed in Bulletin 121. Paris green or the other arsenicals may be used with Bordeaux mixture. In that case it is not necessary to add much extra lime.

[13] Use Bordeaux mixture 1-to-11 formula. Pure copper sulphate solution, 1 pound to 15 gallons or more, may be used when there is no foliage. It is cheaper but does not adhere so well as does Bordeaux mixture. Directions for making and applying these mixtures are given in Bulletin 121. The Paris green or other arsenicals may be mixed with the Bordeaux mixture and both may be thus combined in one application.

Generally, the scab may be controlled by three treatments if they are made promptly and very thoroughly. These three, as numbered above, are 3, 4 and 5. Winter treatment against the scab is not recommended. See pages 386, 387.

For treatment of lice or aphis, scale insects, rust, sooty blotch and fly speck consult the special discussion of these subjects on previous pages.

## APRICOT DISEASES.

### FRUIT ROT.

The ripe rot of apricot fruit is due to the same fungus as that causing ripe rot of cherries. It is discussed on page 401.

### LEAF-SPOT.

(*Cylindrosporium padi* Karst.)

The fungus which causes apricot leaf-spot also causes a spotting of the fruit. When the leaves are attacked the diseased part usually drops out leaving a clean cut hole. In severe attacks the foliage is riddled with holes. The same fungus also attacks the foliage of plums and cherries. For the treatment, see plum leaf-spot, page 432.

### GUMMING.

See discussion of the gumming of stone fruits, page 418.

## APRICOT INSECTS.

### CURCULIO.

This insect does great damage to apricots by causing wormy fruit. Frequently a large part of the crop becomes infested and drops unless measures are taken to kill the beetles before they deposit their eggs in the young fruit. This is best done by jarring as recommended in the discussion of this insect under the heading "Plum curculio." It is very important that the jarring begin *as soon as the fruit sets*, because the curculios do much injury to the very young apricots.

The other insects mentioned as attacking the peach are also liable to trouble the apricot.

## BLACKBERRY AND DEWBERRY DISEASES.

### ANTHRACNOSE.

Blackberry anthracnose is caused by the fungus which affects raspberries in a similar way. For description and treatment see page 437.

### LEAF-SPOT.

(*Septoria rubi* Westd.)

*Description.*—Blackberries, dewberries and raspberries are subject to a leaf-spot disease caused by *Septoria rubi*. The small, pale spots of dead leaf-tissue finally become dotted with black specks, the pycnidia of the fungus. In some seasons the foliage is quite seriously injured by this disease.

*Treatment.*—Goff[14] has tried treatment with Bordeaux mixture and other fungicides but the results were not encouraging. No successful line of treatment is known.

RUST.

Blackberry rust is caused by the same fungus which causes the rust of raspberries. For description and treatment see page 438.

## BLACKBERRY AND DEWBERRY INSECTS.

The principal injurious insects of blackberry and dewberry are the cane borer and the saw fly. These also attack the raspberry. They are discussed on pages 439, 440.

## CHERRY DISEASES.

BLACK KNOT.

It is claimed that the black knot of the cherry is caused by the same fungus as that which causes the black knot of the plum. If it is not the same fungus it certainly is so closely related that the same description of gross characters and the same lines of treatment will apply to both. For description and treatment, see "Plum black knot," page 431.

FRUIT ROT.

(*Monilia fructigena* P.)

*Description.*—The rotting of the ripening fruit on the tree often causes great injury to the crops of cherries, plums, apricots and peaches. A fungous parasite attacks the fruit and causes it to rot. The same fungus under favorable conditions, especially when the weather is warm and moist, and the growing shoots are tender and succulent, may attack the ends of the twigs and also the blossoms. Frequently the rotted fruit remains on the tree over winter in a mummied form and the following season under favorable weather conditions, becomes covered with spores by means of which the disease is propagated. These mummied fruits, therefore, should be collected and destroyed before growth starts in spring, as a preventive of infection.

[14] Goff, E. S. Journ. Myc., **7**: 22.

The fungus sometimes does considerable damage by destroying the blossoms but usually it causes most loss by attacking the fruit. It occurs on unripe fruits but usually spreads most rapidly and does most damage when the fruits are nearly or quite ripe, especially if they hang in clusters or touch each other. Under weather conditions very favorable to its growth it may practically ruin the ripening crop within a short time.

*Treatment.*—The disease may be prevented to some extent by treatment with fungicides, but it is extremely doubtful whether it can be entirely controlled by spraying. Bordeaux mixture applied soon after the fruit sets persists, to some extent, until the fruit ripens and will show on the ripe fruit. The other mixtures which have been tried are of doubtful utility, taking all things into consideration. For both this disease and the leaf-spot it is suggested[15] that the trees be sprayed just before blossoming and again immediately after the blossoms fall, but no line of treatment is recommended.

Powell[16] recommends picking the fruit before it is fully ripe; that is, before it softens.

### LEAF-SPOT.

### (*Cylindrosporium padi* Karst.)

*Description.*—The leaf spot of cherry, plum and apricot, which is caused by the fungus named above, at first appears as minute spots on the leaf, a sixteenth of an inch or less in diameter. On cherry and plum especially, the spots may have a reddish-tinged margin. Afterwards they increase in size and may enlarge to an eighth of an inch or more across. The spots soon become dark brown with a pale center, and in many cases the diseased tissue loosens and drops out leaving a clean-cut hole in the leaf. For this reason the disease is sometimes called the "shot-hole disease."[17] The disease may cause serious injury for sometimes the

---

[15] Beach, S. A. N. Y. Agr. Exp. Sta. Bul. 117 : 134.

[16] Powell, G. Harold. Del. Agr. Exp. Sta. Rep. 1897 : 193.

[17] Duggar has shown that a shot-hole appearance in plum and peach foliage is not always due to fungous attacks but may be caused by other injuries, notably by spraying with improperly prepared mixtures. See Proc. Soc. for Promotion Agr. Science, 1898, and Cornell Agr. Expt. Sta Bul. 164 : 385.

trees are nearly defoliated by it. Should this occur when the trees are heavily loaded with fruit, as it is especially apt to do with plums, the trees may be much weakened in vitality[18] and consequently more liable to winter injury.

*Treatment.*—It has been shown conclusively that the leaf blight may be controlled by proper treatment with Bordeaux mixture but in cherry orchards the treatments cannot be made at the most favorable time for controlling the disease because the spray mixtures adhere to the fruit and injure its market value.[19] From our present knowledge of the subject no line of treatment can be positively recommended for bearing cherry trees, but it is suggested that Bordeaux mixture (1-to-11 formula) be applied just before the blossoms open and again just after they fall as a partial preventive of leaf-spot and fruit rot.

### GUMMING.

See discussion of gumming of stone fruits under gumming of the peach, page 418. To prevent gumming in the forks of cherry trees Wickson[20] advocates training the tree in such a way as to give wide, open forks where the branches join the trunk.

## CHERRY INSECTS.

### CURCULIO.

This insect injures cherries by causing the fruit to become wormy. It is the same insect as the plum curculio and is discussed more at length under the subject "Plum curculio," on page 433.

*Treatment.*—The curculio is commonly fought in cherry orchards by one or two applications of Paris green or its equivalent at the rate of one pound to three hundred gallons of water. Two or three pounds, at least, of unslaked lime should be added for every pound of the poison. Slake the lime and add to the mixture the same as in making Bordeaux mixture. The poison may be mixed with the Bordeaux mixture if desired as

---

[18] Beach. Annual Rept. this Station, 1896 : 385 ; also Bulletin 98.

[19] Beach. Ann. Rept this Station, 1896: 406.

[20] Wickson, E. J. California Fruits, p. 284.

stated on page 339. Make the first application immediately after the blossoms have fallen and a second about ten days later.

### FRUIT BARK BEETLE.

This is the same as the fruit bark beetle of peach discussed on page 422.

### MAGGOT.

(*Rhagoletis cingulata ?* Loew.)

This insect resembles the apple maggot in all of its stages. It attacks sour cherries and probably plums to some extent. It has recently proven a serious pest in some of the large cherry orchards of Western New York. A similar if not identical species occurs in some of the middle and eastern states.

The life history of this insect has not been fully worked out. It is known, however, that the eggs are laid nearly or quite under the skin of the ripe fruit, and that the maggots work in the flesh. In depositing the egg the female makes a small round hole, probably with her ovipositor, through the skin. Until the fruit has been sufficiently eaten to cause decay, this small hole is all there is to indicate that the maggot is inside. For this reason newly infested fruit is often quite difficult to detect. When full grown the maggots leave the fruit, as shown by specimens kept under observation by Lowe, and form the puparium or resting stage in any convenient place, such as the bottom of fruit baskets. If the fruit is on the ground the maggots will go into the ground for a short distance. The adults emerge in the spring early enough to lay their eggs in the earliest varieties of sour cherries. Egg laying probably continues throughout the season of the latest varieties. The number of broods is not positively known. The insect probably winters in the pupa stage.

*Treatment.*—This species will probably prove, like the apple maggot, a difficult one to control. Good cultivation and keeping the packing houses free from rubbish will undoubtedly have some effect. Lowe found in the infested orchards which he examined that the insect first attacked the fruit on a few trees in one section and gradually spread to other sections of the orchards. This indicates that it spreads slowly, and also that destroying

the crop on the few trees that were first attacked, while an heroic measure, would probably be the means of preventing serious infestation of the orchard.

### PLANT LICE.

Several species of plant lice attack the cherry. As a rule they do not occur on sour cherry trees in sufficient numbers to do serious injury. Sweet cherry trees, however, are quite frequently attacked by the black cherry aphis, *Myzus cerasi* Fab. The lice are nearly black in color. Like other species of plant lice they multiply with great rapidity, soon covering the under sides of the leaves and causing them to curl and wilt. The lice prefer the young leaves at the tips of the branches, and will be found there in greatest numbers.

*Treatment.*—Where practical cut off and burn the ends of the twigs bearing the young and worst infested leaves. The trees should then be sprayed with whale oil soap solution or kerosene emulsion as recommended for the apple plant louse, page 396.

### SLUG.

This insect also infests pear trees. It is discussed more fully under the heading "Pear slug" on page 430. The remedies to be used are there given.

## CURRANT DISEASES.

### LEAF SPOT.

(*Septoria ribis* Desm. and *Cercospora angulata* Wint.)

These two fungous diseases which cause spotting of currant leaves have been successfully treated with Bordeaux mixture by Pammel.[21] The spot diseases are usually seen to some extent each season, and in some cases their attacks are so severe as to nearly defoliate the bushes. Judging from the experiments thus far tried, the spraying should begin soon after the fruit sets, and continue at intervals of about two weeks until the fruit begins to color. One or two applications may be made after the fruit is

[21] Pammel, L. H. Iowa Agr. Exp. Sta. Bul. 13: 45–46; Bul. 17: 419–421; Bul. 20: 716–718; Bul. 30: 289–291.

harvested if thought necessary. One objection to the treatments before the fruit ripens is that the mixture is liable to remain on the fruit and injure its appearance when ripe.

Goff[22] has recently reported excellent results from a single thorough spraying with Bordeaux mixture made during the first week in July, after the fruit was harvested.

### CANE BLIGHT.

*Description.*—This disease is characterized by wilting of the foliage and dying of the canes. Healthy and diseased canes commonly occur in the same hill. The disease may appear at any time during the growing season but it is most virulent about the time the fruit is ripening. It appears that there are two forms of cane blight. The form occurring in the Hudson Valley[23] is caused by a sterile fungus which works in the pith and under the bark. In the western part of the State there occurs a currant cane blight which, according to Durand,[24] is caused by the semi-parasitic fungus, *Nectria cinnabarina* (Tode.) Fr.

*Treatment.*—Probably the most practical method of fighting cane blight is to go over the plantation at frequent intervals during the summer and cut out and burn the affected canes. In doing this, care must be taken to cut well below the lowest point of the disease. After cutting into diseased wood the pruning knife should be disinfected before it is used on healthy wood. A 5 per ct. solution of carbolic acid is a good disinfectant for this purpose.

Cuttings should be taken only from plants known to be healthy.

## CURRANT INSECTS.

### PLANT LICE.

The first indications that the plant lice are at work are the small bladder-like galls on the upper surfaces of the leaves. The galls soon turn red, increase in size and may finally include nearly the entire leaf. The lice congregate in large numbers in the corres-

[22] Goff, E. S. Wis. Agr. Exp. Sta. Bul. 72 : 30.

[23] For an account of currant cane blight in the Hudson Valley, see Bul. 167 of this Station, page 291.

[24] Durand, E. J. A Disease of Currant-Canes. Cornell Univ. Agr. Exp. Sta. Bul. 125.

ponding pockets on the under sides of the leaves. Several species work on the currant, but the most common is the currant plant louse, *Myzus ribis* Linn.

*Treatment.*—The infested bushes should be sprayed with a solution of whale oil soap, one pound to seven gallons of water. The first application is the most important, and should be made as soon as the lice appear. The spray should be directed so as to hit the under surfaces of the leaves. A second and third application about a week apart may be necessary.

SAW FLIES.

(*Nematus ventricosus* Klug.) (*Pristiphora grossulariæ* Walsh.)

*Description.*—The first named species, which is popularly known as the imported currant worm, is much more troublesome than the latter, which is a native American species. The larvæ are the common "worms" that attack the leaves of both the currant and gooseberry, often quickly denuding the bush.

The adults are four-winged flies about the size of a house-fly. Their bodies are prominently marked with yellow. They appear during the first warm days of spring and deposit their eggs in single rows on the under sides of the midribs and larger veins.

The eggs hatch in about ten days. The newly hatched larvæ are light green in color. At first they eat small holes through the leaves, but as they grow larger, devour the entire leaf with the exception of the midrib and larger veins. Their color changes with successive molts until, when about full grown and before the last molt, they are a moderately dark green color, marked with numerous black dots. After the last molt they are plain green. When full grown, which is in about three weeks, they measure about three-fourths of an inch in length. The cocoons are formed either just above or a short distance below the surface of the ground, attached to the plant. The adults escape late in June or early in July. Eggs are soon deposited for a second brood, which passes to the chrysalis stage before winter sets in.

*Treatment.*—As soon as the "worms" appear spray the bushes with hellebore, one ounce to two gallons of water. Direct the spray toward the under sides of the leaves. It is important to make the first application while the "worms" are yet very young.

Otherwise it is more difficult to poison them. If a second application is necessary use an ounce of hellebore to one gallon of water.

## GOOSEBERRY DISEASES.

### LEAF-SPOT.

The fungi which cause the leaf-spot diseases of the currant also attack the gooseberry. They are discussed on page 405

### MILDEW.

(*Sphærotheca mors-uvæ* (Schw.) B. & C.)

*Description.*—The mildew usually makes its first appearance on the young shoots and leaves. Here it will first attract the observer's attention as a collection of some bright, frosty substance. On close examination it will be found to be composed of a mass of glistening white threads that spread rapidly under favorable conditions. The more mature portions of the fungus take on a dirty brown color. Later it attacks the fruit in a similar manner. The threads often spread over the berries until they are entirely covered with a mass of brown, felt-like mold, which renders them unsalable.

European varieties, when grown in this country, are particularly susceptible to the attacks of mildew. Many of those varieties produce very large, fine fruit and are so desirable both for home and market that they would be grown to a much greater extent than they now are, were it not for the attacks of this disease.

When setting out a plantation, a site should be chosen where the land is well underdrained and where there is an abundant circulation of air. Branches that droop close to the ground should be pruned back and the ground underneath kept free from grass or weeds, preferably by frequent shallow cultivation, otherwise by mulching.

*Treatment.*—Spraying should begin early in spring after the buds break and before the first leaves unfold, using one ounce of potassium sulphide for two gallons of water. This treatment is repeated at intervals of from seven to ten days depending on the amount of rain that comes to wash off the applications. After the

fruit is marketed spraying is no longer resorted to although the mildew may continue through the season on the ends of growing shoots.

### SUN SCALD.

The ripening fruit of the gooseberry is liable to sun scald. The skin at first has a bleached appearance and afterwards the fruit shrivels and drops. The conditions which bring about this trouble are not well understood. It sometimes causes serious loss.

*Remedy.*—The only remedy known at present is to pick the fruit while it is green, *i. e.*, unripe.

## GOOSEBERRY INSECTS.

The saw flies which attack the gooseberry are of the same species as those which are found on the currant. See page 407.

## GRAPE DISEASES.

The various prominent vineyard diseases of the State, with the exception of the anthracnose, may be controlled by spraying according to directions given for treating the black rot, page 411.

### ANTHRACNOSE.

(*Sphaceloma ampelinum* DeBy.)

*Description.*—This disease attacks any tender portions of the growing vine. When the leaves are affected dark spots are first formed on their surface. As the disease advances these spots enlarge, and irregular cracks are often formed through the dead tissue. Frequently many of these small cracks run together, forming a long irregular slit through the leaf. Similar marks are formed on the tender shoots, though they are not so noticeable. When the fruit is attacked the disease is sometimes called bird's-eye rot. Circular spots are formed on the surface of the berry. The spots may be of different colors and usually have a dark border; as the spots enlarge and eat in, a seed is often exposed in the center. The berries do not rot, but the tissue becomes hard and wrinkled. Sometimes the disease girdles the stem of a fruit-cluster, cutting off the supply of sap from the grapes beyond the diseased line and causing them to shrivel and die.

*Treatment.*—Anthracnose does not spread as rapidly as some other vineyard diseases, neither does it yield as readily to treatment. When a vineyard is badly infested with anthracnose, it requires prompt attention and careful treatment to control the disease. It is not satisfactorily controlled by the Bordeaux mixture treatment alone, which is recommended below for black rot and mildew. It is suggested that in addition to such treatment the plan be followed which is advocated by certain European authorities, of applying a warm saturated solution of copperas (iron sulphate) in spring when the buds are swelling but before they begin to open. One per ct. or more of sulphuric acid may be added to the solution before it is applied. This solution must be handled with care as it is very caustic. It is applied with swabs or if the acid is not used it may be sprayed.[25] It is essential that the work be done thoroughly, covering all the surface of the canes.

Mr. T. H. King, Trumansburg, N. Y., reports that he has been successful in controlling this disease upon the Vergennes, which is very susceptible to the disease, by pulling the loose bark from the vines and spraying thoroughly with Bordeaux mixture in the spring before the buds start and again three or four weeks later.

### BLACK ROT.

(*Læstadia bidwellii* (Ell.) V. & R.)

*Description.*—This disease may usually be found first on the leaves, where it forms circular, bright reddish brown, or pale brown spots on which there appear later little black dots or pimples. Within the black pimples are developed the germs of the fungus which causes the disease. These germs are given forth and washed by rain, or blown by wind, to other leaves or fruit where they grow and form new diseased spots. In the fruit it also forms circular spots and develops black pimples like those formed on the leaves. The diseased fruit withers, turns black, and becomes hard and shriveled, clinging to the stems sometimes till the following spring. The disease may also attack the green shoots.

---

[25] Beach, N. Y. Agl. Exp. Sta. Bul. 86, :79. 1896.
Lodeman, Spraying of Plants, pp. 45, 152, 294.

*Treatment.*—All diseased fruit should be taken from the vineyard, since it is capable of spreading the disease the following spring. Trimmings from the fruit containing diseased berries ought not to be returned to the vineyard in the shape of compost as is sometimes practiced, since the diseased berries are liable to spread the black rot through the vineyard.

This disease may be successfully controlled by thorough spraying if done at the right time. Bordeaux mixture, 1-to-11 formula, is used for this purpose. It is prepared as directed in Bulletin 121. The applications are made as follows:

I. Just as the pink tips of the first leaves appear.

II. From ten days to two weeks after the first spraying.

III. Just after the blossoming.

IV. From ten to fourteen days after the third treatment.

V. If a fifth treatment is necessary let it follow the fourth after an interval of from ten to fourteen days.

VI. If a later treatment than the fifth is needed, ammoniacal solution of copper carbonate should be used; as that is less liable to stain the fruit than the Bordeaux mixture. Directions for preparing it are given below.

The number of the treatments should be governed by the weather conditions and the severity of the disease. If the vineyard is not badly diseased, and if there is not an excessive amount of hot, wet weather, four treatments may be found sufficient for all practical purposes.

*The early treatments are extremely important.*

*Thorough treatment is essential to success.*

Paris green or other arsenicals which are recommended against the insects, may be combined with Bordeaux mixture, but not with the ammoniacal solution of copper carbonate.

*Ammoniacal solution of copper carbonate.*—The formula usually given for making this solution is as follows: Dissolve five ounces of copper carbonate in three pints of ammonia of 26° strength. When ready to apply, dilute with water so as to make fifty gallons. The undiluted solution may be preserved for some time in tightly closed vessels.

Penny finds[26] that the use of the strong undiluted ammonia in

[26] Del. Ag. Exp. Sta. Bul. 22.

dissolving the copper is wasteful and unsafe. He recommends the following method of making the solution. "To one volume of 26° Beaumé ammonia (the strong ammonia of commerce) add from seven to eight volumes of water. Then add copper carbonate, best in successive quantities, until a large portion remains undissolved. The mixture should be vigorously agitated during the solution and finally allowed to subside, and the clear liquid poured off from the undissolved salt. A second portion should then be made by treating the residue of the former lot with more ammonia diluted as before, then with the addition of fresh copper carbonate, in every case with vigorous stirring or agitation. The method of making in successive lots will result in a richer solution of copper, at least unless an unwarranted length of time be taken." He finds that much less ammonia is required to dissolve a given amount of copper carbonate in this way than according to the method formerly followed of adding the strong, undiluted ammonia directly to the copper carbonate.

### CHLOROSIS OR YELLOW LEAF.

The name is applied to a grape disease in which the foliage turns yellow, later becoming brown. It is common in some parts of the State.

Chlorosis is more likely to appear in wet seasons. Some varieties, as the Diamond, are much more susceptible than others. In some seasons portions of the leaves may become yellow but eventually regain their normal color so that at the close of the season the vine appears to be in a healthy condition. In other instances the yellow color extends over the entire leaf; brown, dead patches appear; the leaf curls and eventually drops from the vine. If the vine loses its leaves two or three seasons in succession it is likely to die. One striking peculiarity of the disease is the fact that a badly diseased vine may appear by the side of a perfectly healthy vine of the same variety.

The cause of chlorosis, as given by foreign investigators, is the presence of a large amount of lime in the soil which prevents the roots from taking up an amount of iron sufficient for satisfactory growth. Their experiments show that the difficulty may be overcome by applying a small amount of sulphate of iron around

affected plants. But since there are a number of good American varieties that are not subject to chlorosis, perhaps the better method to pursue is to plant only such varieties as are known to be free from this trouble.

The standard varieties given in the following list are, so far as we know, practically exempt from chlorosis:

| | |
|---|---|
| Moore Early, | Concord, |
| Winchell, | Catawba, |
| Delaware, | Vergennes, |
| Worden, | Agawam. |
| Niagara, | |

### DOWNY MILDEW.

(*Plasmopara viticola* (B. & C.) Berl. & DeT.)

*Description.*—In some sections of the State the downy mildew causes considerable loss to the grape grower. It may attack nearly every portion of the current season's growth,—leaves, shoots and fruit. Its first appearance on the leaves, that will be noticed by a casual observer, is in dry, brick red spots on the upper surface. On the under side of the leaf the diseased area will be covered with the interlaced threads of the fungus. The red spots increase in size until in many instances the entire leaf dies and falls to the ground. It frequently causes the berries to turn dull brown and become soft and shrivelled. This appearance of it has been commonly called "brown rot." The spores are found on the threads which issue from the under side of the leaves or from the stems or fruit, the whole giving when fresh a glistening white downy appearance from which the disease takes its most common, and preferable name of "downy mildew." Later the parts of the fungus exposed on the surface assume a gray hue and so the disease has also been known as "gray rot." Some varieties, like Delaware, appear to be quite susceptible to the attacks of the disease and none of the cultivated varieties are known to be entirely exempt.

*Treatment.*—It may be successfully treated in the manner described for black rot. See page 411.

### POWDERY MILDEW.

(*Uncinula spiralis* B. & C.)

*Description.*—Unlike many of our fungous diseases, the powdery mildew flourishes best during the dry weather of mid-summer. It usually begins its attack in June, though it may appear earlier. Its name is descriptive of its appearance, as it forms dull white, powdery patches on the young shoots on the upper surface of the leaves. When the fungus is abundant it seriously checks the growth of the vines by absorbing the nourishment that should have gone to their development. The berries may be attacked at any stage of growth and they are injured or destroyed in the same way as are the shoots or leaves.

*Treatment.*—It may be successfully treated in the manner described for the black rot. See page 411.

## GRAPE INSECTS.

### CANE BORER.

(*Amphicerus bicaudatus* Say.)

A small, cylindrical beetle, which works as a borer in its mature stage. It injures the grape by burrowing into the stems in spring near the base of the new growth and breeds in the dying wood. The larva sometimes feeds upon the grape canes.

*Treatment.*—As it breeds in the dying wood, careful cutting away and destroying of such wood will help to check the insect.

### GRAPE-VINE FLEA-BEETLE.

(*Haltica chalybea* Ill.)

*Description.*—The adult insects are shining steel-blue flea-beetles measuring about one-fifth of an inch in length. They live during the winter under the bark of the old vines or in rubbish in the fields. They emerge from their winter quarters during the first warm days of spring, and feed upon the opening buds and young leaves. Egg laying begins late in April or early in May. The eggs are placed singly near the buds or upon the leaves and hatch in about ten days. The young larvæ are dark brown in color but soon become prominently marked with black dots and patches. They are full grown in from three to four weeks at which time they measure about a quarter of an inch in length.

They feed on the leaves, devouring only the soft parts at first, but finally eating irregular holes through the leaves. When ready to pupate they go a short distance into the ground. The adults emerge during the latter part of June or early in July. They probably feed during all of the summer, finally seeking shelter for the winter as above indicated.

*Treatment.*—The vines should be sprayed with Paris green, one pound to fifty gallons of lime and water, just before the buds begin to swell. Much pains should be taken to make this application thorough. Later, when the worms appear on the leaves, Paris green may be applied at the usual strength, one pound to 150 gallons of lime and water, or combined with Bordeaux mixture. Both upper and under surfaces of the leaves should be covered.

### GRAPE FRUIT WORM.

### (*Eudemis botrana* Schiff.)

*Description.*—The young caterpillars feed within the grapes finally causing them to turn dark colored and to wither. This injury is sometimes mistaken for the black rot. After devouring the soft parts of one grape the caterpillar goes to another, fastening the two together by a silken thread. This may be continued until several in a bunch have been destroyed by one caterpillar. The young caterpillars are very light green in color with a brown head. When full grown they measure about one-fourth of an inch in length and are dark olive green in color tinged slightly with red. The cocoon is formed on a leaf and is partially composed of two small pieces cut out of the leaf. The adults emerge in about ten days. The fore-wings have a bluish tinge and are marked with brown, while the posterior wings are dull brown. The moths are small, measuring nearly half an inch from tip to tip when the wings are spread. The eggs are probably laid late in June or early in July. There is probably but one brood annually in this State.

*Treatment.*—As the caterpillars spend most of their lives within the grape berries, spraying will have little or no effect. There seems to be no better way than picking and destroying the infested fruit and the leaves containing the cocoons.

### GRAPE LEAF HOPPER.

(*Typhlocyba vitifex* Fitch.)

There are several species of leaf hoppers which attack the grape but this species is probably the most common in this State. These little leaf hoppers are often erroneously called thrips. They jump quickly when disturbed.

*Description.*—The adult insects measure about one-eighth of an inch in length. They vary greatly in color but the prevailing color is usually light yellowish green. The back and wings are ornamented with bright red, yellow and brown. They are found upon the vines from spring until fall. They feed together, sucking the sap from the leaves, principally from the under surface, causing them to turn brown in patches. Writers disagree as to the egg-laying habits of this species. The young resemble the adults in form but are not provided with wings and are green or yellowish green in color. There are several broods during the season. Some of the adults of the last brood hibernate in any convenient rubbish about the vineyard.

*Treatment.*—The vineyards should be kept free from rubbish. Much good may be done by thoroughly spraying the vines with kerosene emulsion, one part to from seven to ten parts of water, or whale oil soap, one pound to seven gallons of water. This is not entirely satisfactory as many of the leaf hoppers will fly before the insecticide reaches them, but some benefit is derived from the emulsion or soap solution that remains on the leaves as it undoubtedly makes them offensive to the insects.

A practical method of combating this insect is found in what is popularly known as the shield method. The shield consists of a frame with a cloth stretched over it and saturated with kerosene oil, with tar softened until it is very sticky or with some other sticky substance. When ready for use it is carried in a horizontal position between the rows. The vines are agitated at the same time and as the insects fly or jump into the air many of them will come in contact with the sticky surface where they soon die or are wet with kerosene which is fatal to them. This method should be used during the warm part of the day and should be continued every day until the insects are materially lessened in numbers.

### GRAPE VINE SAW FLY.

(*Blennocampa pygmæa.*)

*Description.*—The larva of this saw fly is a yellowish-green slug, with numerous rows of black dots across the body. They feed together principally upon the under sides of the leaves. The life history of this species is similar to that of the currant saw fly. See page 407. There are two annual broods.

*Treatment.*—The infested vines should be sprayed with hellebore, one ounce to two gallons of water. If the spraying is not done until the larvæ are half grown or over, use one pound of hellebore to one gallon of water. Much pains should be taken to wet the under surface of the leaves. Paris green, one pound to 150 gallons of lime and water, may be used before the grapes are half grown.

## PEACH DISEASES.

*Caution.*—Before discussing the diseases and insect enemies of the peach, attention should be called to the fact that the foliage of stone fruits and especially of the peach is *peculiarly liable to injury* from Paris green, London purple or copper in solution. For this reason the former should not be used stronger than one pound to about three hundred gallons of water and at least two or three times as much freshly slaked lime as poison should be used. It is doubtful whether more than two sprayings with Paris green or London purple should be given even if diluted to the strength just stated. If Bordeaux mixture is used especial care should be taken to have an excess of lime in the mixture.

### CROWN GALL OR ROOT KNOT.

*Description, etc.*—In this disease large knots appear on the roots. The knots are irregular in form, rough on the surface, soft and spongy within and of various sizes, from the size of a pea to the size of a fist. They may occur on any part of the root system, but are found most commonly at the point where the roots branch off from the trunk; hence the name crown gall. Occasionally, they occur also on the trunk above ground. In all cases the knots are detrimental to the tree and when they occur at the crown the tree is worthless.

The disease is common in some of the nurseries in the State. The cause of it is wholly unknown. There are indications that it is infectious but this has not been proven.

Similar knots occur on the roots of the raspberry, blackberry, pear, apple, plum, apricot, grape, and a few other woody plants. Among fruit growers it is the popular opinion that the disease is the same on all of these different plants, and that any one of them may communicate the disease to the others. However, this has not yet been demonstrated by carefully conducted experiments.

*Treatment.*—No remedy is known. Affected trees should never be planted. It is not even safe to plant trees from which the knots have been removed. Avoid planting fruit trees in soil known to be badly infested by the disease.

### FRUIT ROT OR RIPE ROT.

(*Monilia fructigena* P.)

The ripe rot of the peach is caused by the same fungus as that which produces the ripe rot of cherry and plum. It is discussed on page 401.

*Treatment.*—Chester[27] who has given special attention to this subject advocates spraying with Bordeaux mixture just before the blossoms open and again after the fruit sets. Spray with copper acetate (finely powdered, 8 ounces to the barrel), when the fruit is ripening. Copper acetate does not discolor the fruit as Bordeaux mixture does. Observe the caution given above concerning the liability of injuring peach foliage by spraying.

### GUMMING.

The formation of gum by the apricot, cherry, peach or plum may follow any injury by cuts or bruises or by the attacks of insects or fungi. The young bark of stone-fruit trees may be nearly covered with gum pockets as a result of bruises from hail stones. Wounds made in pruning are often followed by a flow of gum. It has been shown by some experiments that where the peach is pruned during the period of greatest vegetative activity,

[27] Chester, F. D. Ninth Ann. Rep. Del. Ag. Exp. Sta., 1897: 28.

*i.e.*, from April to August, there is a greater production of gum in the wounds than where the pruning is done later[28].

When gumming results from adverse conditions of environment, or from over bearing, excessive pruning or any other cause which severely checks growth, it may often be remedied by making the conditions as favorable for growth as possible, as, for example, by frequent tillage, by the use of stable manure or other fertilizers, by draining the soil, by thinning the fruit to prevent overproduction and by treatment against diseases and injurious insects.[29]

### LEAF CURL.

### (*Exoascus deformans* (Berk.) Fckl.)

*Description.*—The name is descriptive of the disease. The disease is caused by a fungus which not only attacks the leaves but may be found in the twigs as well. The curled leaves become distorted, crumpled, enlarged and curled. The disease may often be detected when the leaves first start from the buds in spring. The diseased leaves eventually fall so that in early summer the tree may be almost defoliated. In 1898 the disease caused a loss of many thousands of dollars to the fruit growers of the State by injury to the trees and by the premature dropping of the fruit which followed the loss of the foliage.

*Treatment.*—It appears to be demonstrated that leaf curl may be largely prevented by spraying with Bordeaux mixture,[30] 1-to-11 formula, in spring before the buds begin to open. Some advise later sprayings but as the peach foliage is very susceptible to injury from the use of spraying mixtures including even Bordeaux mixture, we are not prepared at present to outline a satisfactory line of treatment for the foliage.

### LITTLE-PEACH DISEASE.

This disease appears to have been first described by Taft[31] in

[28] Zeit. f. Pflanzenkrankheiten, **6** (1896) : 58, 59.

[29] For a more complete discussion of this subject see Beach, S. A. "Gumming of Stone Fruits." Amer. Gard., **19** (1898) : 606.

[30] Some advise the use of copper sulphate solution, 1-to-15 or 1-to-20 formula, instead of the Bordeaux mixture, but we advocate the latter because it adheres so well.

[31] Taft, L. R. Mich. Ag. Exp. Sta. Bul. 155 : 303–304.

March, 1898. In October of the same year Smith[32] published a more extensive account of it. It seems to have been known to some extent among peach growers for many years.[33] It is considered to be as contagious and as fatal as the yellows.[34] Dr. Smith describes it as a disease in which the peach fruit is from one-half to one third the diameter of healthy fruit, and it may ripen from one to two weeks later than the healthy fruit. The leaves average, perhaps, one-half normal size and have a sickly color. The larger roots appear to be all right but the ultimate rootlets appear to be diseased. No fungous parasite has as yet been found to be the cause of the trouble. The remedy now advocated is the same as for yellows, viz.: Dig out and burn the diseased trees.

### YELLOWS.

The best treatment for peach yellows is to dig out and burn the diseased trees. It has not been found that a healthy tree planted where a diseased tree stood is more apt to have the yellows than if planted elsewhere, other conditions being similar. Among the characteristics of the disease may be mentioned the appearance of clusters of willowy shoots, sickly color of the foliage, premature ripening of the fruit and red colored spots in the flesh of the fruit.

## PEACH INSECTS.

### BORER.

(*Sannina exitiosa* Say.)

*Description.*—The adult insects are beautiful moths. The male measures about an inch and the female an inch and a half from tip to tip of the expanded wings. The general color is deep steel blue. The female has a broad band of orange across the abdomen. They appear during May and early June. The eggs are usually deposited on the bark at or near the surface of the ground, although they are sometimes deposited higher up on the trunk

---

[32] Smith, E. F. Notes on the Michigan disease known as "Little Peach." *Fennville* (Mich.) *Herald.* Oct. 15, 1898.

[33] Mann, W. T. Proc. W. N. Y. Hort. Soc., 1899 : 142.

[34] Robinson, F. and Morrill, R. Proc. W. N. Y. Hort. Soc., 1899: 142.

and even upon the larger limbs. The eggs are only a few days in hatching and the young larvæ quickly work their way into the sap wood where they feed during the remainder of the season. They remain dormant during the winter in their burrows, forming cocoons in the spring and finally issuing as moths as above indicated. There is but one brood annually.

*Treatment.*—As preventive treatment numerous washes have been suggested. In a series of experiments which included a large number of trunk washes Slingerland[35] reports the best success with gas tar. The tar was warmed slightly to facilitate handling and applied to the trunk. It "apparently kept out four-fifths of all the borers, only a small percentage of the trees became infested and no injury resulted to the trees." He also states that in his experience "the tar did not interfere with the growth of the trees in the least." This treatment should be combined with the digging out method. Again, he states that in this State the applications of washes, such as gas tar, should be made between June 15 and July 1, and "should remain in perfect working order until October 1." It should be remarked that gas tar is a substance of very variable composition and instances are known where disastrous results to the trees followed its use in the manner which is here described.

Keeping wood ashes about the base of the trees is considered by some extensive growers to be an effective treatment. The surest treatment is to kill the borers every spring and fall with a flexible wire inserted in their burrows or to remove them with a knife. After the borers are dug out in the spring in May, mound six inches high or more with fine earth, packing it tightly against the base of the tree. This compels the moths to lay their eggs on the bark above the top of the mound. About the first of August carefully examine the trunk by removing a little earth at the top of the mound where the borers, if any, may be easily found. Remove them with the knife. A second search should be made in October and a third one during the following May. If the earth is left at its usual level without mounding, the eggs

[35] Cornell Univ. Agr. Exp. Sta. Bull. 176, pp. 217, 224–225.

are deposited so near the roots that the borers can easily work downward to where it will be difficult to find them.

BUD MOTH.

(*Tmetocera ocellana* Schif.)

Sometimes very destructive to the peach. The caterpillars bore into the buds and even into the wood beneath. Treatment same as recommended on page 390.

CURCULIO.

The plum curculio is sometimes a serious pest in the peach orchard. Remedies for this insect are discussed under "Plum curculio" on page 433.

FRUIT-BARK BEETLE.

(*Scolytus rugulosus* Ratz.)

*Description.*—The adult insects are black, somewhat cylindrical beetles about one-tenth of an inch long and about one-third as broad. They appear early in the spring and bore small round holes through the bark to the sap wood. The eggs are laid beneath the bark and the grubs feed on the sap wood, making characteristic galleries. Pupation takes place under the bark, the adults finally gnawing their way out. There are probably several broods in one season. It attacks a variety of fruit trees.

*Treatment.*—As a preventive measure trees should be kept in a healthy, vigorous condition; as such trees are less liable to attack than weak ones. Trees which become badly infested should be dug up and burned.

## PEAR DISEASES.

FIRE BLIGHT.

(*Bacillus amylovorus* (Burr.) De Toni.)

*Description, etc.*—This disease shows itself in the dying of entire twigs, large branches or even the tree itself. It is a bacterial disease that has long been known but whose real nature was first discovered in 1879 by Dr. Burrill of Illinois. It was afterwards studied very carefully at this Station by Dr. Arthur[36] and more

[36] See Annual Reports of this Station, 1884: 357; 1885: 241; 1886: 275.

recently by Mr. M. B. Waite[37] of the United States Department of Agriculture.

The disease usually makes its first appearance soon after the blooming period. The young fruit clusters and the twigs bearing them turn black. The leaves also blacken and die but do not fall. If affected twigs are not removed the disease rapidly works its way down into the larger branches.

According to Waite[38] the blight germs do not live over winter in the soil. Moreover, he finds that in the majority of the affected branches even, the germs die soon after the close of the growing season. It is only in a small proportion of the affected branches that the germs survive the winter. Such "hold over" cases, as he calls them, become centers of infection during the following spring. Branches in which the germ is alive do not show a definite line of demarcation between the healthy and diseased wood. The infection is spread chiefly by insects, especially by bees.

Pear blight attacks several other pomaceous plants—the apple, crab apple, quince, etc.

*Treatment.*—Although the cause of the disease is now well known no thoroughly successful method of treating it has been found. The only thing that can be done is to cut out and burn the diseased parts as soon as the blight appears. This should be done promptly; for the disease spreads rapidly. Waite recommends[39] that all trees subject to the disease be thoroughly inspected several times during the growing season. He says that the two most important periods for such inspection are: (1) About two weeks after blooming; (2) just before the leaves drop.

The cutting should be done several inches below the lowest point of discoloration, in order to make sure that all of the disease is removed. Care should be taken never to cut into healthy wood with a knife or saw that has come in contact with diseased wood, until after the tool has been disinfected by wiping it off with a cloth saturated with kerosene, a five per ct. solution of carbolic acid, or some other germicide.

---

[37] Waite M. B. The Cause and Prevention of Pear Blight. Year-book U. S. Dept. Agr. 1895: 295–300.

[38] l. c.

[39] Fifty Seventh Ann. Rep. N. Y. State Agrl. Soc. 1897: 787.

LEAF BLIGHT.

(*Entomosporium maculatum* Lev.)

*Description.*—This is caused by a parasitic fungus which makes its appearance early in the spring. It is first found on the new leaves where it appears as bright, reddish spots on the upper surface. These spots rapidly increase in size and later the leaves turn brown and finally fall. It attacks the young twigs in the same manner and frequently kills back many of them. When the fruit is attacked the bright colored spots are first formed. These spots soon become dark colored, and spread out in every direction; the surface of the pear becomes rough where attacked by the disease and at these places the growth is checked. Sometimes the fruit becomes cracked as it does when attacked by the scab. This disease appears to be more severe in States south of New York and in regions near the Atlantic coast than it is in the interior of the State, where it causes little damage except as a nursery disease.

*Treatment.*—The treatment advocated for pear scab is also recommended for this disease when it appears in the orchard.

LEAF SPOT.

(*Septoria piricola* Desm.)

*Description.*—This disease may be readily distinguished from the one last described if the two are carefully compared. The leaf spot when fully developed has a somewhat angular outline and whitish center in which appear small black specks, the bodies in which the spores of the fungus are borne.

*Treatment.*—The only experiments in treating this disease which have come to our notice are those by Duggar[40] who advocates similar treatment to that recommended against leaf-blight.

SCAB.

(*Venturia pirina* Aderh.[41])

*Description.*—This disease is caused by a fungus very similar, both in appearance and in the injury which it does to leaves and

[40] Duggar, B. M. Cornell Univ. Agrl. Exp. Sta. Bul. 145, 602–604.

[41] This is the ascosporic stage of *Fusicladium pirinum* (Lib.) Fckl.

fruit, to the apple scab fungus. It robs the leaves of the nourishment which they are preparing for themselves and for the growth of the tree and fruit; it spots the fruit and in very severe attacks causes it to become one sided, distorted or cracked. While it does not kill the trees or branches as the blight may do, still it is believed that no disease, year after year, causes so great loss in pear orchards of New York State as does the scab. Some varieties appear to be comparatively exempt from its attacks while others suffer quite severely. With varieties which are thus injured by its attacks, it weakens the tree, it lessens the yield, it makes a large part of the fruit unsalable or of an inferior grade, and even the No. 1 fruit sells for less in the market than it would were it free from the blemishes caused by the scab. It is also conceded that fruit free from scab keeps better and is handled easier than the fruit of the same variety blemished with scab spots.

*Treatment.*—This disease may be controlled by treatment with Bordeaux mixture.[42] Paris green or its equivalent may be used at the same time against the codling moth and leaf eating insects. The general treatment recommended for the scab and other pear diseases is given on page 431.

## PEAR INSECTS.

### BARK LICE.

See under "Oyster-shell Bark-louse" and "Scurfy Bark-louse."

### BLISTER MITE.

(*Phytoptus pyri* Scheuten.)

*Description.*—The first indications of the presence of this insect in the spring are the small reddish spots on the upper surfaces of the young leaves. These spots indicate where the adult mites that have been hibernating on the twigs burrowed into the leaves to deposit their eggs. These spots finally turn black. The eggs soon hatch and the young mites burrow into the leaf, feeding upon its soft tissues. Toward fall the adults migrate to the twigs to remain all winter. There are probably several broods annually.

[42] Beach, S. A. Bul. 84 of this Station.

*Treatment.*—The infested trees should be sprayed in the spring a short time before the buds burst, either with kerosene emulsion diluted with seven parts of water or with a solution of whale-oil soap, one pound to seven gallons of water. One thorough application has been found to be sufficient. Pruning closely in winter and burning the twigs will also aid in checking the insect.

### BORER.

See "Sinuate Pear Borer."

### BUD MOTH.

The eye-spotted bud moth which attacks pears, is the same as that which infests apple trees. It is also known as the bud worm. Treatment for it is given under apples. See page 390.

### CASE BEARERS.

PISTOL-CASE-BEARER. CIGAR-CASE-BEARER.

These insects also infest apple trees and have been discussed under apples. See page 391.

### CODLING MOTH.

This insect which causes so much loss to apple growers by causing wormy apples, also attacks pears. It may be treated as recommended on page 394.

### LEAF BLISTER MITE.

See "Blister Mite."

### PEAR MIDGE.

(*Diplosis pyrivora* Riley.)

*Description.*—The first indication of injury by this insect is the stunted and dwarfed fruits. If one of these fruits is cut open the maggots will be found near the core. The adult insect is a small two-winged fly somewhat resembling a diminutive mosquito. According to Prof. J. B. Smith[43] it appears early in the season before the buds of the pear blossoms open. The eggs are probably laid in the blossoms and hatch within a few days. The young mag-

[43] N. J. Agr. Exp. Sta. Bul. 99, page 5.

gots bore into the embryo fruit, where they remain feeding near the core until full grown. When ready to pupate they leave the fruit and go into the ground to a depth of from one-half an inch to two inches. After remaining unchanged for a time they make "oval cocoons of silk covered with grains of sand" (Smith). This probably takes place any time from early spring to mid-summer, depending upon the locality, although in this State most of them go into the ground in June. They remain as pupæ in the ground all winter, emerging as adults in the spring. Lawrence pears are especially liable to attack.

*Treatment.*—This insect has proved a very difficult one to control. Experiments have been made with a view to destroying the pupæ in the ground, but it has been found that in order to successfully check the insect a dangerous amount of the insecticides tested must be applied to the soil. Hand picking, where practical, is probably the most satisfactory method of checking the insect. It should be done in June.

### OYSTER-SHELL BARK-LOUSE.

This insect also has been discussed under "Apple Insects," page 398. It is sometimes very injurious to young pear trees.

### PEAR PSYLLA.

(*Psylla pyricola* Först.)

*Description.*—This insect causes injury in two ways. First, by sucking the sap; second, by disfiguring trees and fruit. Its presence is usually betrayed by the honey dew secreted by the young, wingless forms. The honey dew afterwards becomes covered with a black mold giving the leaves and twigs a black unsightly appearance.

The adult is an active four-winged insect measuring about one-tenth of an inch in length. It has been compared to a miniature seventeen year locust. A number of broods are produced during the summer, and the adults which live through the winter are distinct in form from the summer adults. They appear early in the spring and deposit their eggs in protected places on the bark. The eggs hatch within a few days and the little larvæ, or nymphs, at once commence to suck the juices from the young leaves and

twigs. Where the nymphs are numerous they take so much nourishment from the trees that the new growth is seriously checked. The whole tree assumes a stunted, unhealthy appearance. As a natural result the fruit crop is greatly lessened and, in some instances, trees have been killed. The first brood in the spring probably does the most direct injury. A favorite place for the young nymphs is in the axils of the leaves and at the base of the fruit stems. Within two or three days after hatching they cover themselves with honey dew which finally becomes so abundant as to disfigure the leaves and fruits, the amount of injury done in this way varying of course with the number of nymphs.

*Treatment*.—The young nymphs are most easily reached. Close watch for them should be kept when the leaves are unfolding in the spring. As soon as the nymphs are found spray the trees thoroughly with kerosene emulsion diluted with about ten parts of water[44] or with a solution of whale-oil soap, one pound to from five to seven gallons of water. Two applications about ten days apart will probably be necessary. It is important to begin the work before the nymphs have covered themselves with honey dew as it is then much more difficult to reach them with a spray.

### SAN JOSÈ SCALE.

### (*Aspidiotus perniciosus* Comst.)

*Description*.[45]—This insect may be briefly described as a small, nearly circular, ash-gray scale with a prominent dark nipple at the centre. These are the female scales. They are always greatly in excess of the males and are chiefly responsible for the injury which is done. The San José scale attacks the bark, leaves and fruit. In common with certain other scale insects it causes a crimson discoloration of the sapwood and fruit. It multiplies with great rapidity. In examining a tree for this insect the trunk and larger limbs and the fruit should receive an especially close scrutiny as the scales are often found here in large numbers when only scattering on the smaller limbs.

---

[44] Some growers use a much stronger emulsion with apparently no injury to the trees.

[45] This insect is discussed more in detail in Bulletin 136 of this Station, pages 587–593.

*Treatment.*—The treatment of this insect is a matter of so much importance that it will be made the subject of a separate bulletin. Where it has once become firmly established it probably cannot be exterminated. When recently introduced it has in some cases been exterminated by burning the infested trees, or by thorough treatment with whale-oil soap at the rate of two pounds to a gallon of water, or by both. The most effective known method of treatment is fumigation with hydrocyanic acid gas. The use of kerosene and water or crude petroleum is still in the experimental stage and cannot as yet be recommended for general use.

### SCURFY BARK-LOUSE.

(*Chionapsis furfurus* Fitch.)

*Description.*—This insect sometimes occurs in large numbers upon young pear trees. The scales are a dirty white color, broadly wedged shape in outline and vary in length from about one-sixteenth to nearly one-eighth of an inch.

The life history of this species is very similar to that of the oyster-shell bark-louse; with both species the eggs are retained under the parent scale during the winter. The eggs vary greatly in number, from ten or twelve upwards, as many as seventy-five having been found under a single female scale. They hatch from the first to the middle of May. There is probably but one brood annually. The male scale is much smaller than the female, is elongate, with nearly parallel sides and is a clearer white color. The adult male is a delicate two winged insect.

*Treatment.*—The treatment for this insect is the same as for the oyster-shell bark-louse. (See page 398.)

### SINUATE PEAR BORER.

(*Agrilus sinuatus* Oliv.)

*Description.*—This insect was recently introduced into this country from Europe. It has become seriously injurious in some parts of the eastern United States. It makes long zigzag galleries between the bark and wood, finally girdling and killing the tree. It is said to live two years in the larval stage. The larva is slender, and has the first segment back of the head

much enlarged. The adult is a small, slender beetle. The eggs are laid on the bark of the tree.

*Treatment.*—When a tree becomes infested it is very difficult to get the borers out, and it is usually impractical to attempt to do so. As preventive measures some good may be done by placing mechanical obstructions on the trunks, such as tarred paper wound about the trunk, or wire netting; the object being to prevent the adult from depositing eggs in the bark. Whitewashing the trunk with ordinary whitewash to which enough Paris green has been added to tinge it slightly, or with a strong soap wash, one pound of whale oil soap to one gallon of water, has been recommended. The trunks should be kept covered with one of these washes during May and June.

### PEAR SLUG.

(*Selandria cerasi* Peck.)

*Description.*—The adult insect is a small, dark-colored, four-winged fly. The slugs make their appearance in the latter part of May or early June. At first light in color they soon become darker and are covered with an abundance of slime. The slugs feed on the upper surface, skeletonizing the leaves, and where very abundant they cause serious injury. Leaves that are badly injured wither and fall.

*Treatment.*—It upon examination it is found that the insects are likely to appear in sufficient mumbers to cause much damage, no time should be lost in spraying the trees with Paris green. If the trees are being treated for fungous diseases the Paris green should be combined with the Bordeaux mixture. A second brood of this insect usually appears in August. The only thing to be done is to spray when the indications are that the slugs are numerous enough to be injurious. On low trees they are sometimes treated with air-slaked lime or road dust, by throwing the dust or lime on the leaves.

GENERAL TREATMENT AGAINST DISEASES AND INSECTS WHICH ATTACK THE PEAR.

| When to spray. | What to use and what the treatment is for. |
|---|---|
| 1. Just before blossoms open. | Bordeaux mixture[46] against the scab, leaf blight, leaf spot and canker disease. |
| 2. Just after blossoms fall. | Bordeaux mixture[46] against the scab, leaf blight, leaf spot, etc. |
| | Paris green[47] against codling moth and leaf eating insects generally. |
| 3. From ten to fourteen days after 2. | Bordeaux mixture[46] against the scab, leaf spot, leaf blight, etc. |
| | Paris green[47] against codling moth and leaf eating insects generally. |

[46] Use Bordeaux mixture, 1 to 11 formula. Directions for making and applying are given in Bulletin 121. The Paris green or other arsenicals may be mixed with the Bordeaux mixture if desirable to apply both at one time.

[47] Use Paris green at the rate of 1 pound to 150 gallons of water with about two pounds of fresh slaked lime added to make it adhere and to prevent injury to foliage. Green arsenite of copper, arsenite of lime, or other poisons may be used instead of Paris green as directed in Bulletin 121. These arsenicals may be mixed with Bordeaux mixture instead of water at the same rate as given above. In that case not much extra lime need be added.

For treatment of fire blight, bud moth, case bearers, etc., consult the special notice of these subjects on previous pages.

## PLUM DISEASES.

### BLACK KNOT.

(*Plowrightia morbosa* (Schw.) Sacc.)

*Description.*—This disease causes swellings underneath the bark, finally rupturing it and developing a spongy texture covered with dark olive-green mold. In this stage the summer spores are produced which spread the infection to other trees.

Late in the season the knot becomes hard with a black surface, which finally becomes covered with fine black pimples inside of which are matured the winter spores. The winter spores escape late in winter or early in spring and serve to spread the disease. A more extended discussion of this disease is given in Bulletin 40 of this Station, and in the Annual Report for 1893, page 686.

*Treatment.*—The best known remedy for this trouble is to cut out and burn the knots. They can be found most readily after the leaves have dropped in the fall. They should then all be removed before mid-winter so as to be sure of destroying them before the spores mature and escape. Early in the summer the new knots should be watched for and promptly removed and destroyed. The infection frequently comes from the knots on neglected plum or cherry trees along fence rows or in neighboring orchards. In removing the knots the branch should be cut off three or four inches or more below where the knot appears, so as to remove the threads of the fungus that may extend down the branch to a considerable distance from the knot. The same disease also affects various wild plums and wild and cultivated cherries. It is rarely found on sweet cherries but sometimes is very destructive to the Morello class.

### FRUIT ROT.

(*Monilia fructigena* P.)

The ripe rot or fruit rot of the plum is caused by the same fungus as that which causes the rot of the cherry fruit.

*Treatment.*—The treatment advocated for the leaf-spot will hold this disease in check somewhat. The spraying of the ripe fruit presents the same difficulties as it does with the cherry. See page 402.

When there is reason to fear that the disease will attack the blossoms, treatment with Bordeaux mixture should be made just before the blossoms open. Thinning the fruit is no doubt a partial preventive, because when the rot attacks one of a cluster of fruits it usually spreads till every fruit in the cluster is diseased. When the fruits do not touch each other the disease is less destructive.

### LEAF SPOT.

(*Cylindrosporium padi* Karst.)

This disease is discussed under leaf spot of the cherry. See page 402. In general it is more liable to produce the shot hole appearance on plum foliage than on cherry foliage.

*Treatment.*—As a result of extended experiments it can be stated that the plum leaf spot may be controlled by thorough

treatment with Bordeaux mixture, 1-to-11 formula. In some seasons two treatments are most economical, but under conditions favorable to the disease at least three should be given.[48] If but two treatments be made give the first about ten days after the blossoms fall, but not later than June 1; make the second treatment about three weeks later. The disease may be better controlled by three treatments and usually three treatments will be most profitable. Make the third from three to four weeks after the second.

YELLOWS.

The Japanese plums are subject to a disease which has the appearance of peach yellows. It occurs on trees which have been worked on plum roots as well as on those which are on peach roots. No remedy is known.

The treatment recommended is the same as that which is recommended for peach yellows—dig out and burn the diseased trees.

## PLUM INSECTS.

### PLUM CURCULIO.

(*Conotrachelus nenuphar* Herbst.)

*Description.*—The adult is a small, peculiar, gray beetle. It passes the winter under the bark of trees, or under rubbish, and comes forth early in the spring to deposit its eggs in the young fruits, commencing as soon as they are formed. It does this by puncturing the tissue and inserting the egg. After the egg is deposited, the beetle cuts a crescent-shaped groove around one side of the puncture evidently to prevent the growing tissue from crushing the egg. The eggs hatch in a few days when the little worm, or larva, at once commences to feed on the fruit causing much of the infested fruit to fall while still young and that which remains on the trees ripen prematurely and soon decay.

The curculio does not confine its attacks to plums, but it usually infests plum orchards and if left unmolested, often destroys an entire crop.

*Treatment.*—It has been found that the beetles' manner of protection is to fall to the ground when disturbed. Here they

[48] Beach, S. A. Sixteenth Ann. Rep. this Station, 1897 : 211.

curl up so as to resemble bits of bark. Advantage is taken of this habit in fighting the insect by a process known as jarring. The trees are jarred by three or four strokes with a padded crutch or mallet and the insects are caught on sheets spread underneath the tree and destroyed.

The curculio catcher commonly used in the vicinity of Geneva is one made by Mr. J. B. Johnson, Geneva, N. Y. The frame over which the sheet is stretched is attached to a two-wheeled cart. The sheet slopes downwards to the center where an opening allows the bugs to be swept into a tin box underneath the sheet and between the wheels. A slit at one side allows the cart to be run directly under the tree and two or three jars bring down the bugs which are swept into the box above mentioned, by means of a short handled broom. The cultivated ground is made smooth by rolling to prepare it so that the cart wheels will pass over it readily. Jarring should be begun as soon as the fruit sets and be continued as long as the curculio are found in sufficient numbers to pay for jarring, which is usually for about three weeks. Early morning is the best time to do this work. Towards the middle of the day, especially on bright days, they are more active and apt to fly.

The beetle feeds on the plum leaves and for this reason spraying the trees with Paris green or London purple has been advocated. No doubt the insects may be killed to some extent in this way but the foliage of stone fruit trees is particularly liable to injury from Paris green or London purple so that these poisons must be used sparingly and much diluted. When the insect is abundant the jarring is undoubtedly the best way of controlling the pest.

### GREEN FRUIT-WORMS.

The green fruit worms sometimes are so abundant on the plum as to cause much damage. The treatment recommended is given on page 395.

### PLANT LICE.

Several species of plant lice attack the plum. They collect in great numbers on the under sides of the leaves, causing them to curl and finally drop off. The infested trees should be sprayed with whale-oil soap, one pound to seven gallons of water, as soon

as the lice appear. The spraying should be directed from the under side so as to reach all of the lice.

## QUINCE DISEASES.

### CANKER OF TREE. BLACK ROT OF FRUIT.

The canker of the tree and black rot of the fruit of the quince are caused by the fungus which causes similar trouble with the apple and pear. For a discussion of the disease and remedial measures see page 382.

### BLIGHT. (FIRE BLIGHT.)

This disease is caused by the same parasite which produces the fire blight of the pear. It is discussed on page 422.

### LEAF BLIGHT AND FRUIT SPOT.

(*Entomosporium maculatum* Lev.)

*Description.*—Fruit spot and leaf blight of the quince are caused by the same fungus that causes pear leaf blight. When a fruit is attacked, numerous small black specks appear on its surface. As the spots increase in size they often grow into each other and form a large, dark, diseased area. The disease does not extend so deep into the tissue of the fruit as to make it entirely worthless, but the market value is greatly lessened. When the fruit is attacked before it has reached its full size, it often occurs that the quinces, like the diseased pears, are misshapen and undersized. Greater damage is done to the trees when the leaves are severely attacked. The loss of foliage in midsummer not only leaves the fruit undeveloped but is a severe check to the growth and vigor of the tree.

*Treatment.*—Favorable results in treating this disease with the Bordeaux mixture are reported. It is suggested that the treatment recommended for apple scab be used against quince fruit spot and leaf blight, making the first spraying when the blossom buds have appeared, the second just as the blossoms are falling, and a third about two weeks latter.

### RUST.

(*Gymnosporangium* spp.)

*Description.*—The rust is due to a fungus which becomes established and develops within the tissues of the quince branches or

fruit. It causes knotty branches and peculiarly distorted fruit on which there appear tiny fringed pits filled with orange colored dust giving the diseased parts quite a brilliant appearance.

In a different form this rust fungus attacks the red cedar and the common juniper, forming galls on their branches. In these galls are developed spores which, distributed by the winds to quinces, juneberries, hawthorns and apples, become established on these trees and cause the rust. Usually the rust is not abundant enough on quinces to cause serious injury. It is usually recommended that the cedar and juniper trees in the vicinity be destroyed to prevent the breeding of the fungus on them and that the rusted fruit or branches also be removed and destroyed. The former recommendation is not always practical, and whether the latter course will do any good has not been definitely determined.

## QUINCE INSECTS.

### BORER.

These are the same as those described under apple insects, page 389. The trunks of the trees should be examined carefully in spring and fall and the borers dug out. Various other remedies have been advocated but apparently none of them take the place of systematically removing the grubs.

### CODLING MOTH.

(*Carpocapsa pomonella* Linn.)

This insect is the same as that which causes wormy apples and pears as described on page 394. It should be treated by spraying with Paris green or some other arsenical poison as soon as the fruit sets, followed by one or two later applications at intervals of ten days, or even less if heavy rains fall in the meantime. The poison thus used is also recommended for the curculio mentioned below. It may be combined with Bordeaux mixture when that is used against fruit spot and leaf blight, using one pound for one hundred and fifty gallons.

### CURCULIO.

(*Conotrachelus crataegi* Walsh.)

*Description.*—The adult insect is somewhat larger than the plum curculio. It is broader just back of the thorax and is a

brownish gray color mottled with white. Its life history as worked out by Slingerland[49] is substantially as follows: The winter is passed in the grub stage in an earthen cell two or three inches below the surface of the ground. Here the transformation to the pupa takes place in the spring. The time when the adults emerge varies with the weather conditions. They may appear any time from late in May until late in July. The adults feed on the young quince fruits and possibly on the leaves. The eggs are laid in "little pits" made by the female beetles in the fruit. The eggs hatch in a few days and the grubs feed in the fleshy part of the fruit until full grown when they go into the ground to pass the winter. There is but one brood annually.

*Treatment.*—As with the plum curculio, jarring is considered the most satisfactory method of combating this insect. The trees are jarred in the same manner as plum trees for the plum curculio. The "curculio catcher" is mounted on low wheels so that it can be used under the quince trees. As the time when the curculios appear varies, probably with the season, no definite time for beginning the work of jarring can be given. The trees should be watched after the last week of May. The presence of the curculios will be easily ascertained by a few trials at jarring. If they are found the jarring should be continued as long as they are numerous.

## RASPBERRY DISEASES.

### ANTHRACNOSE.

(*Glœosporium venetum* Speg.)

*Description.*—This disease ordinarily makes its first appearance on the young canes when they are less than a foot high. Its presence may be detected by the appearance of small dark or purple colored spots, which rapidly increase in size and change from the dark color to the brown or dirty white in the center as the fungus feeds outward in all directions leaving the dead tissues behind. The slightly raised outlines of the spots vary in color from dark brown to bright purple. In severe attacks the spots are so numerous that they soon coalesce and form continuous blotches that may nearly or completely girdle the cane. The

[49] Cornell Univ. Agr. Exp. Sta. Bul. 148.

effect on the cane is practically the same as if so much bark had been removed with a knife. While anthracnose is preëminently a disease of the canes it may occur on any part of the plant above ground. It is most destructive to black raspberries but also attacks purple raspberries and blackberries and perhaps still other species of *Rubus*. Red raspberries appear to be exempt.

*Treatment.*[50]—Since, in most instances, a raspberry plantation reaches its limit of profitable production when three or four years old it seems that a rotation of crops, combined with sanitary measures, is the surest method of preventing loss from this disease. As the disease lives over winter in the canes, the old canes, together with the badly diseased new ones, should be removed as soon as the fruiting season is over.

Experiments have shown that the disease may be checked by spraying with Bordeaux mixture, beginning when the new canes are about six inches high and keeping them well protected with the mixture until the fruit is two-thirds grown. Ordinarily, however, spraying for anthracnose is not likely to pay.

### RUST.

(*Puccinia peckiana* Howe. Syn. *Cæoma nitens* Schw.)

*Description, etc.*—This disease is often called the orange rust on account of the orange color of the spores which are produced in dense masses on the underside of the rusted leaves. Sometimes the spore masses occur also on the canes. The fungus attacks blackberries, dewberries and raspberries. It is quite common on wild plants and where these are growing in the vicinity of cultivated varieties the diseased plants among them should be destroyed to prevent them from becoming a source of infection.

*Treatment.*—Clinton[51] states that the fungus enters the very young underground shoots and growing up through the canes finally appears in the leaves. Since the fungus grows within the canes and infection appears to take place at the root, the only preventive treatment which can be recommended is digging out

[50] Paddock, W. The Anthracnose of Black Raspberry. N. Y. Agr. Exp. Sta. Bul. 124.

[51] Clinton, G. P. Orange Rust of Raspberry and Blackberry. Ill. Agr. Exp. Sta. Bul. 29.

and burning the infested plants immediately upon the first appearance of the disease. This treatment will materially check the disease. Affected plants may usually be detected before the rust breaks out on the leaves. The diseased leaves have a pale orange tinge and present a sickly appearance which one soon comes to recognize as characteristic of rust-infested plants. Diseased canes are also apt to be much freer from prickles than are healthy canes.

### LEAF-SPOT.

(*Septoria rubi* Westd.)

A leaf-spot of raspberries is caused by the same *Septoria* which attacks blackberries. It is discussed on page 400. The disease seems to be less troublesome on raspberries than it is on blackberries.

### ROOT KNOT.

The roots of raspberries are often covered with galls which are similar to those found on peach roots (see page 417) and are probably due to the same cause. Our knowledge of these root galls is imperfect. To both the raspberry and the peach they are very injurious. There is some reason for believing that the disease may be communicated from the peach to the raspberry and *vice versa*. Hence it is advisable to avoid planting peaches on soil in which raspberries have knotted badly. Neither should raspberries be planted where peaches have been affected with the root knot.

## RASPBERRY INSECTS.

### CANE MAGGOT.

(*Phorbia* sp.)

*Description.*—This insect works only in the new shoots causing them to wilt and finally die. This wilting of the shoots is first noticeable in May. The adults first appear in spring toward the latter part of April. The eggs are laid near the tips of the new growth. They hatch within a few days. The litttle white maggots which emerge from them burrow into the pith of the shoot. According to Slingerland[52] they burrow downward in the

[52] Cornell Univ. Agr. Exp. Sta. Bul. 126, p. 58.

pith until they have reached about half the length of the canes when they work nearly out to the bark and each makes a tunnel around the shoot thus girdling it from the inside. They continue feeding on the pith at the point where the girdling was done, almost severing the shoots. After doing this injury the maggots proceed to burrow downward in the pith, finally reaching the base of the shoots where they transform to the pupa stage. This point in their development is probably reached some time in June. They remain in this condition until the following April.

*Treatment.*—As the insects work inside the shoots they cannot be reached with a spray. Undoubtedly the most practical method of treatment consists in cutting off the wilted shoots several inches below the wilted portion.

### SAW FLY.

### (*Monophadnoides rubi* Harr.)

*Description.*—The adult insects are about the size of a house-fly. They appear in the spring and are most abundant in May. The eggs are laid from the under side of the leaf within the leaf tissue. They are usually placed along the midrib and larger veins. The tissue above the eggs turns a light brown color, causing the infested leaves to become spotted. The eggs hatch in about a week. The young larvæ are light green in color and are well covered with spine-bearing tubercles. They feed at first on the softer tissues, but finally the entire leaf with the exception of the midrib and larger veins is devoured. They have also been known to feed on the tender bark of the new growth and to do some injury to the flowers and fruit. Toward the latter part of June they go into the ground near the bushes upon which they have been feeding, to a depth of two or three inches, where the cocoons are spun in which the transformation to the pupa stage slowly takes place. The transformation is not completed until the following spring. There is but one brood annually.

*Treatment.*—If the leaves become spotted as above indicated, they should be examined, and if indications of the eggs or larvæ are found they should be sprayed with hellebore, one ounce to the gallon of water, as soon as the young larvæ are numerous. Both the upper and under surfaces of the leaves should be covered.

Where only a few bushes are infested the insect may be easily checked by brushing the larvæ onto the ground about the bushes. If the ground is soft and loose most of the larvæ will be unable to return.

## STRAWBERRY DISEASES.

### LEAF SPOT.

(*Sphærella fragariæ* (Tul.) Sacc.)

This disease is also called strawberry "rust" or "leaf-blight." It frequently causes much damage by injuring the foliage so that the plants are incapable of perfecting a full crop of fruit even though a full crop has set, or as Thaxter states, it also attacks the fruit stems and hulls, "cutting off the supply of nourishment from the berries and disfiguring them by the withering of the calyx."

When the spots first appear on the leaves they are of a deep purple color, but later they enlarge and the center becomes gray or nearly white. Portions of the infested leaves frequently assume bright red tints and when badly diseased finally wither and die.

*Treatment.*—Bordeaux mixture, 1-to-11 formula, used as advocated by Hunn in the Annual Report of this Station for 1892, p. 682, gives beneficial results. When setting a new plantation be particular to remove the diseased leaves before taking the plants to the field, or if the plants must be trimmed in the field, the diseased leaves should not be left where they can communicate the disease to the new foliage as it grows out. The following treatment is then suggested:

Spray the newly set plants soon after growth begins and follow with three or four treatments during the season, as seems necessary. The following spring, spray just before blossoming and again in from ten days to two weeks. As soon as the fruit is gathered it is generally a good plan to mow off the foliage if badly diseased and burn it if the beds are to be fruited a second season. Should drought follow, the plants may not recover from this treatment sufficiently to give a satisfactory crop the following year.

Varieties differ greatly in their susceptibility to leaf spot. Consequently, one of the best ways to avoid loss from this disease is to plant those varieties which are least subject to it.

## STRAWBERRY INSECTS.

### CROWN BORER.

(*Tyloderma fragariæ* Riley.)

*Description.*—The adult insect is a dark brown beetle, of the curculio group, measuring about one-sixteenth of an inch in length. The beetles appear in June or July. The eggs are laid on the plant above ground not far from the crown of the root. The eggs hatch into small, white, legless grubs. These grubs burrow down into the crown where they feed until full grown. Pupation takes place within the excavation, the beetles finally escaping about the middle of August. They are unable to fly. There is but one brood annually.

*Treatment.*—The crown borer is most injurious on old beds, and as each plant that becomes infected is eventually doomed it will usually be most practical to dig up and burn the infested vines.

### GRUBS.

The larvæ or grubs of the common May beetle and oth ♀ closely related species, frequently do much injury by feeding on the roots of strawberry plants.

The beetles lay their eggs in sod ground. The eggs hatch into white grubs, which feed on the roots of various plants until the third year, when they pupate, finally coming from the ground as beetles.

Since the grubs live in the ground until the third year after the eggs were laid, it is good practice not to use land for strawberries before the third or fourth year after it was in sod.

### SAW FLY.

(*Emphytus maculatus* Nort.)

This insect is only occasionally injurious in this State. The adult is a four-winged fly of the general habits of the currant and raspberry saw flies. The larvæ feed upon the leaves. There are probably two broods annually, the second brood passing the winter in the ground.

The larvæ may be killed by spraying the infested plants with hellebore, one ounce to the gallon of water.

# INDEX.


APPLE DISEASES: Page.
Belting of the Fruit ... ..... 384
Canker ..... 382
Fire Blight..... 383
Fly Speck ..... 383
*Fusicladium dendriticum* ..... 385
General Treatment Against... 399
*Gymnosporangium*..... 384
Leaf Spot ..... 383
*Leptothyrium pomi*..... 383
*Phyllachora pomigena*..... 388
*Phyllosticta* ..... 383
*Ræstelia* ..... 384
Russeting of the Fruit..... 384
Rust ..... 384
Scab..... 385
Scald ..... 387
Sooty Blotch ..... 388
*Sphæropsis malorun*..... 382
*Venturia inæqualis* ..... 385

APPLE INSECTS:
*Anisopteryx pometaria*..... 393
*Aphis mali*..... 396
Apple-tree Tent-Caterpillar.... 389
*Aspidiotus perniciosus*..... 398
Borers ..... 389
Bud Moth..... 390
Canker Worms ..... 392
*Carpocapsa pomonella* ..... 394
Case Bearers ..... 391
*Chionapsis furfurus* ..... 398
*Chrysobothris femorata*..... 389
Cigar Case Bearer..... 391
*Clisiocampa americana*..... 389
Codling Moth ..... 394
*Coleophora fletcherella*..... 391
*C. malivorella*..... 391
Fall Canker Worm..... 393
Flat-Headed Apple-Tree Borer. 389
General Treatment Against.... 399
Green Fruit Worms..... 395
Maggot ..... 395
*Mytilaspis pomorum*..... 398
Oyster-Shell Bark-Louse..... 398
*Paleacrita vernata*..... 393
Pistol Case Bearer ..... 391
Plant Lice..... 396
Rail Road Worm ..... 395
*Rhagoletis pomonella*..... 395
Round-Headed Apple-Tree Page.
Borer ..... 389
San José Scale..... 398
*Saperda candida* ..... 389
Scale Insects ..... 398
*Schizoneura lanigera* ..... 397
Spring Canker Worm..... 393
*Tmetocera ocellana* ..... 390
Woolly Louse ..... 397
*Xylina*..... 395

APRICOT DISEASES:
*Cylindrosporium padi*..... 400
Fruit Rot ..... 399
Gumming ..... 400
Leaf Spot ..... 400

APRICOT INSECTS:
Curculio ..... 400
San José Scale..... 398, 400, 428

BLACKBERRY DISEASES:
Anthracnose ..... 400
Leaf Spot..... 400
Rust ..... 401
*Septoria rubi*..... 400

BLACKBERRY INSECTS ..... 401

CHERRY DISEASES:
Black Knot..... 401
*Cylindrosporium padi*... ..... 402
Fruit Rot..... 401
Gumming ..... 403
Leaf Spot..... 402
*Monilia fructigena* ..... 401

CHERRY INSECTS:
Curculio ..... 403
Fruit Bark Beetle..... 404
Maggot ..... 401
*Myzus cerasi* ..... 405
Plant Lice..... 405
*Rhagoletis cingulata*..... 404
San José Scale.....398, 428
Slug ..... 405

CURRANT DISEASES:
Cane Blight ..... 406
*Cercospora angulata* ..... 405
Leaf Spot. ..... 405
*Nectria cinnabarina* ..... 406
*Septoria ribis*..... 405

CURRANT INSECTS: Page.
*Myzus ribis* ..... 407
*Nematus ventricosus* ..... 407
Plant Lice ..... 406
*Pristiphora grossulariæ*..... 407
San José Scale..... 398, 428
Saw Flies..... 407
"Worms"..... 407

DEWBERRY DISEASES..... 400

GOOSEBERRY DISEASES:
Leaf Spot..... 408
Mildew ..... 408
*Sphærotheca mors-uvæ*..... 408
Sun Scald ..... 429

GOOSEBERRY INSECTS:
See Currant Insects..... 405

GRAPE DISEASES:
Anthracnose..... 409
Black Rot ..... 410
Brown Rot..... 413
Chlorosis..... 412
Downy Mildew ..... 413
Gray Rot..... 413
*Læstadia bidwellii*..... 410
*Plasmopara viticola*..... 413
Powdery Mildew ..... 414
*Sphaceloma ampelinum*..... 409
*Uncinula spiralis*..... 414
Yellow Leaf..... 412

GRAPE INSECTS:
*Amphicerus bicaudatus*.....414
*Blennocampa pygmæa* ..... 417
Cane Borer ..... 414
*Eudemis botrana*..... 415
Flea Beetle..... 414
Fruit Worm ..... 415
*Haltica chalybea*..... 414
Leaf Hopper..... 416
Saw Fly..... 417
Thrips..... 416
*Typhlocyba vitifex*..... 416

PEACH DISEASES:
Crown Gall..... 417
*Exoascus deformans*..... 419
Fruit Rot..... 418
Gumming..... 418
Leaf Curl..... 419
Little Peach..... 419
*Monilia fructigena* ..... 418
Ripe Rot..... 418
Root Knot..... 417
Yellows..... 420

PEACH INSECTS:
Borer ..... 420
Bud Moth ..... 422

PEACH INSECTS—Con. Page.
Curculio..... 422
Fruit Bark Beetle..... 422
San Josè Scale.....398, 428
*Sannina exitiosa*..... 420
*Scolytus rugulosus*..... 422
*Tmetocera ocellana* ..... 422

PEAR DISEASES:
*Bacillus amylovorus*..... 422
*Entomosporium maculatum*... 424
Fire Blight..... 422
*Fusicladium pirinum* ..... 424
General Treatment Against... 431
Leaf Blight..... 424
Leaf Spot..... 424
Scab ..... 424
*Septoria piricola*..... 424
*Venturia pirina*..... 424

PEAR INSECTS:
*Agrilus sinuatus* ..... 429
*Aspidiotus perniciosus* ..... 428
Bark Lice..... 425
Blister Mite..... 425
Borer ..... 426
Bud Moth..... 425
Case Bearers..... 426
*Chionaspis furfurus* ..... 429
Cigar Case Bearer..... 426
Codling Moth..... 426
*Diplosis pyrivora* ..... 426
General Treatment Against ... 431
Leaf Blister Mite..... 426
Oyster-Shell Bark-Louse ..... 427
Pear Midge..... 426
Pear Psylla ..... 427
Pistol Case Bearer ..... 426
*Phytoptus pyri*..... 425
*Psylla pyricola*..... 427
San José Scale..... 428
*Selandria cerasi* ..... 430
Scurfy Bark-Louse..... 429
Sinuate Pear Borer..... 429
Slug ..... 430

PLUM DISEASES:
Black Knot..... 431
*Cylindrosporium padi*..... 432
Fruit Rot..... 432
Leaf Spot..... 432
*Monilia fructigena* ..... 432
*Plowrightia morbosa*... ..... 431
Yellows..... 433

PLUM INSECTS:
*Conotrachelus nenuphar*..... 433
Curculio..... 433
Green Fruit Worms..... 434
Plant Lice..... 434

QUINCE DISEASES: Page.
Black Rot of the Fruit .... ... 435
Blight ..... 435
Canker of the Tree..... 435
*Entomosporium maculatum*... 435
Fruit Rot..... 435
*Gymnosporangium*..... 435
Leaf Blight..... 435
Rust ..... 435
QUINCE INSECTS:
Borers..... 436
*Carpocapsa pomonella*..... 436
Codling Moth ..... 436
*Conotrachelus cratægi*..... 436
Curculio..... 436
RASPBERRY DISEASES:
Anthracnose..... ... 437
*Cæoma nitens* ..... 438
*Glœosporium venetum* ..... 437
Leaf Spot ..... 439
RASPBERRY DISEASES—Con. Page.
*Puccinia peckiana*..... 438
Root Knot..... 439
Rust ..... 438
*Septoria rubi* ..... 439
RASPBERRY INSECTS:
Cane Maggot..... 439
*Monophadnoides rubi* ..... 440
*Phorbia* ... ..... 439
Saw Fly..... 440
STRAWBERRY DISEASES:
Leaf Spot..... ... 441
*Sphærella fragariæ*..... 441
STRAWBERRY INSECTS:
Crown Borer..... 442
*Emphytus maculatus*..... .... 442
Grubs..... 442
Saw Fly ..... 442
*Tyloderma fragariæ*..... 442